MINING engineering

SEPTEMBER 1960

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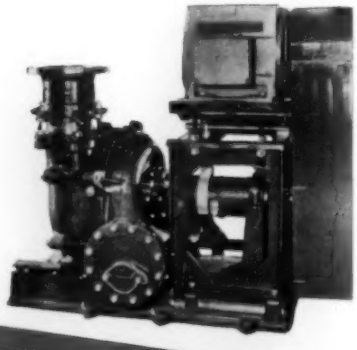

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Wilfley Sand Pumps
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Denver, Colorado, U.S.A. P.O. Box 2330
New York Office: 122 East 42nd Street, New York City 17, N.Y.

COMING EVENTS

Sept. 24, AIME Adirondack Section, mine or mill tours through industrial minerals plant of Gouverneur Talc Co., Gouverneur, N. Y. Dinner at Gouverneur Country Club.

Sept. 27-Oct. 1, symposium on "Physics of Electrostatic Forces and Their Applications," Laboratoire d'Electrostatique et de Physique du Metal, Institut Fourier, Place du Doyen-Gosse. Grenoble, France.

Sept. 30-Oct. 1, AIME Southeast Section, Annual Meeting, Dinkler-Tutwiler Hotel, Birmingham, Ala. Technical program, field trip, special luncheon, and banquet. Saturday, buffet supper and Alabama vs Vanderbilt football game.

Oct. 4-5, SME Board Meeting, Brown Palace Hotel, Denver; AIME Board Meeting, Denver Hilton Hotel, coinciding with SPE Fall Meeting.

Oct. 5, AIME Colorado Plateau Section meeting. Talk by AIME President Joseph L. Gillson.

Oct. 5-7, AIME Rocky Mountain Minerals Conference, Utah Section host, Newhouse Hotel, Salt Lake City.

Oct. 5-8, 9th National Clay Conference, Purdue University, Lafayette, Ind.

Oct. 7-8, Third Quinquennial Alumni Reunion of Minnesota School of Mines and Metallurgy. Open House and technical session, banquet-dance; Northwestern vs Minnesota football game, University of Minnesota, Minneapolis.

Oct. 10-13, American Mining Congress, Mining Show (metal mining-industrial minerals convention, exposition), Convention Center, Las Vegas, Nev.

Oct. 17-18, Symposium on Surface Mining Practices, College of Mines, University of Arizona, Tucson, Ariz.

Oct. 17-19, Drilling and Blasting Symposium, sponsored by Colorado School of Mines, Pennsylvania State University, and University of Minnesota, Colorado School of Mines, Golden, Colo.

Oct. 24-25, AIME-ASME Joint Solid Fuels Conference, Daniel Boone Hotel, Charleston, W. Va.

Nov. 4, AIME Pittsburgh Section, Off-the-Record meeting, Penn-Sheraton Hotel, Pittsburgh.

Nov. 4-5, Joint meeting, AIME Central Appalachian Section and West Virginia Coal Mining Institute, Greenbrier Hotel, White Sulphur Springs, W. Va.

Nov. 7-10, Soc. of Exploration Geophysicists, annual international meeting, Galveston, Texas.

Nov. 15-16, Anthracite Conference, technical and scientific aspects of anthracite utilization, The Pennsylvania State University, University Park, Pa.

Nov. 18, American Mining Congress, coal division conference, Penn-Sheraton Hotel, Pittsburgh.

Dec. 3, AIME Colorado Plateau Section, technical meeting, election of officers, WAAIME dinner-dance, Grand Junction, Colo.

Dec. 5, AIME Arizona Section annual meeting, Pioneer Hotel, Tucson, Ariz.

Jan. 18, 1961, Third AIME Mechanical Working Conference, "Bar and Shaped Products," Penn-Sheraton Hotel, Pittsburgh, Pa.

Feb. 22-25, International Symposium on Mining Research, sponsored by U. S. Bureau of Mines and Missouri School of Mines and Metallurgy, Rolla, Mo.

Feb. 26-Mar. 2, AIME Annual Meeting, Ambassador and Chase-Park-Plaza Hotels, St. Louis.

April 10-12, 44th National Open Hearth Steel Conference and Blast Furnace, Coke Oven, and Raw Materials Conference, Sheraton Hotel, Philadelphia.

Apr. 12-14, International Symposium on Agglomeration, sponsored by SME, SPE, and TMS of AIME, Hotel Sheraton, Philadelphia.

April 26-27, AIME Technical Conference on High-Temperature Materials, Carter Hotel, Cleveland.

Sept. 17-20, Commemoration of the 50th Anniversary of Froth Flotation in the U.S.A., sponsored by AIME: Society of Mining Engineers' Mineral Beneficiation Division, Cosmopolitan Hotel, Denver.

MINING engineering

VOL. 12 NO. 9 SEPTEMBER 1960

COVER *The air-leg drill and the electronic computer—two trademarks of a modern mining company—are portrayed this month by cover artist Herb McClure. The potential value of both computers and data processing machines to the mining industry are outlined on pages 1001-1007.*

ARTICLES

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- *John Nagy, Edwin M. Murphy, and Donald W. Mitchell*

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- *Peter B. Nalle and Leroy W. Weeks*

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MINING ENGINEERING staff, Society of Mining Engineers, and AIME Officers are listed on the Drift page.

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PERSONNEL

THESE items are listings of the Engineering Societies Personnel Service Inc. This Service, which cooperates with the national societies of Chemical; Civil; Electrical; Mechanical; Mining, Metallurgical, Petroleum Engineers, is available to all engineers, members and nonmembers, and is operated on a nonprofit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 60 pct of the first month's salary if a nonmember, or 50 pct if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number. When making application for a position, include 8¢ in stamps for forwarding application to the employer and for returning when possible. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance. Local offices of the Personnel Service are at 8 W. 40 St., **New York 18;** 57 Post St., **San Francisco;** 29 E. Madison St., **Chicago, 1.**

In addition to the listings below, ESPS maintains a more complete file of general engineering positions and men available. Contact nearest ESPS office, listed above. The New York office of ESPS will be open Thursdays until 7:00 P.M. for interviews.

MEN AVAILABLE

Exploration Geologist, B.S. in geology, age 26. Desires position in geological exploration with mining or petroleum firm or related industry, with challenge in work and advancement. Free to travel home or abroad. Married, no children. M-557.

Professional Mining Engineer interested in engineering work leading to production supervisory experience. B.S. in mining engineering 1955, professional engineer, Ontario. Four years employment in office, time study, bonus, calculations, rates, ventilation; underground shrinkage, stoping, cut and fill, geologist, exploration, mapping, surveying. M-558.

Assistant Mine or Plant Superintendent, B.S. in mining geology, 1953. Three years mine engineer for limestone mine, including some plant and quarry work; 2 years surveyor with U.S. Army; 2 years seismograph observer. Prefer eastern U.S. M-559.

Geologist or Mining Engineer, B.S. in geology, age 30. Two years industrial research institute: one year major mining company in all phases open pit and underground mining; surveyor with construction company. Location, no preference. U.S. M-1153-Chicago.

Recent Graduate Mining Engineer, B.S. mining engineering, age 23. Interested in any type of mining, construction, or geological work. Location, open. M-1154-Chicago.

Industrial or Mine Engineer, B.S. in general engineering, working for Master's degree in industrial engineering. Age 46. Chief mine engineer for 8 years in Mexico; plant superintendent and manager (paper-converting plant) 15 years. Acquainted with maintenance, construction of machinery, all paper converting processes, control person at management level. Location, anywhere, M-1155-Chicago.

Mine Operator, B.S. in mining engineering, age 47. Experienced in operating, planning, estimating all phases from exploration to production, open pit and underground. Ten years specializing in production drilling of all kinds, blasting, and exploration. Prefer smaller company. West or Southwest. M-1156-Chicago.

Chief Engineer or Assistant Mine Manager, mining engineer, professional engineering license, 36. Eleven years experience in all phases of underground mining; managerial experience, contract negotiating, legal mining training, machine design, mine evaluation, safety engineering, operational cost accounting. Served as expert mining witness for government, independent consulting and land surveying. $9000. Prefer western U.S. Home, Washington. Se-1323.

Mine Engineer, mining engineer, 29. Seven years experience including economic studies of minerals, exploration and development, market analysis, geologic examination, economic evaluation, planning, for minerals, uranium-vanadium, oil, and coal mining. $7750. Prefer West, East, foreign. Home, Colorado. Se-1274.

Geologist or Geological Engineer, geological engineering, 27, military completed. Six months as exploration geologist for uranium company. Located large mineable uranium deposit. Excellent mineralogy background. One year in municipal engineering, 2½ years doing soils, bridge foundation, quarry and gravel, landslide, and highway investigations. $6000 to $8400. Prefer West, foreign. Home, Idaho. Se-1268.

Industrial Engineer, mining engineer, 38. Six years in industrial engineering including organizing and directing department, one year superintending mine operation, 2 years as administrative assistant to general superintendent, 2 years ore dressing research and experimentation. $7200 to $8400. Prefer San Francisco Bay area. Home, California.

Mining geologist, geology, 31. Two years experience chemical assays, mine contracts, triangulation, topo surveys, underground traverses, computations, mapping and cartography, design and draft mine reduction plant, surface installation machinery design. $7200. Prefer western U.S. Home, California.

Senior Metallurgist, M.S. in metallurgical engineering, 37. Ten years experience in foundry, primary metal working and physical metallurgy. Background includes refractory metals and hard magnetic alloys. Desire responsible position with promotional opportunities. $12,000. Any location. Home. Michigan. Se-1172.

Production Engineer, Mining, mining engineering, 26. Four years, varied experience in mining and heavy construction; three periods of overseas employment in isolated area. Experience as survey party chief, layout, shift boss (tunnel), and heavy construction estimating. Writing and editing experience. Single, 3 years Army service completed. Will travel. $7200. Prefer overseas, or any. Home, California, Se-1065.

Plant Design, M.S. in mining engineering, 37. Application engineer for mineral process equipment; equipment selection, machinery start-up, turnkey projects from analysis, flowsheet, negotiations, pricing. $8400. Prefer San Francisco Bay area. Home, Wisconsin. Se-1061.

Industrial Engineer, geological engineer, 27. Three years plan layouts, time and motion studies, operation analysis, production engineering, budget control, work simplification, incentives, wage administration for mining and retail store. $7200. Any location. Home, California. Se-1020.

Mine Superintendent, mining engineer, 45. Fifteen years experience in charge of exploration, development of mine, plant construction, supervise mining and plant operation and all office administration, block caving, open pit and underground on mercury, chromite, copper, silver, lead, zinc, and tin. $8400. Prefer foreign, any. Home, Mexico. Se-576.

Mine Engineer, mining engineer, 31. Three years experience including layout and planning mining operation, supervise exploration crews, mine surveys, computing ore reserves for silver, lead, zinc, iron ore, and gypsum. $7200. Prefer West. Home, Canada. Se-297.

Geologist, Mine Engineer, geologist, 37. Ten years experience including exploration, plan, budget, evaluation and development, raw prospect to production; uranium, asbestos mining and milling. $12,000. Prefer West or any. Home. New Mexico, Se-196.

POSITIONS OPEN

Chief Mining Engineer, graduate mining with at least 10 years experience in open pit, supervisory, planning, operating, and management experience for iron ore properties. Salary, $15,000 to $18,000. Some foreign assignments. Headquarters, western Pennsylvania. W9410.

Mining and Beneficiation Engineer, graduate mining, metallurgical or civil engineer, with extensive background in mining and ore beneficiation processes, crushing, grinding, etc. Must have wide knowledge of materials handling, flotation, pelletizing, ore dressing, etc. Should have problem-solving ability and imagination to derive new processing concepts. Experience in process designs and calculation, equipment sizing, setting of rates, temperature and pressures. Salary, $15,000 to $16,000. Location, New York City. W-9401 (a).

Superintendent, mechanical and electrical maintenance mining division, graduate mechanical engineer, with 5 to 10 years supervisory experience maintaining heavy-duty equipment used in open pit mining operations such as production trucks, diesel and electric shovels, road graders, bulldozers, drills, etc.; knowledge of electrical maintenance in open pit mine required. Will be responsible for coordination of all mechanical and electrical maintenance; responsible for electric power generation and distribution for all mine operations and adjacent townsite. Salary to start, $15,000. Working knowledge of Spanish required. Location, South America. F9300.

Junior Geologist, graduate, 28 to 32, with 1 to 3 years experience, for metal mine. Will also do some survey and recording. Salary, $6600 to $7800 year. Location, Montana. W9339.

Mining Geologists, graduates, with some experience in mineral exploration or development; background in applied geophysics is desirable. Able to speak Spanish helpful. Three-year contracts, salary open, include air transportation for applicant, wife, and children (maximum of two), include housing, medical and dental care, transportation of household and personal articles, also fringe benefits. Apply by letter with photo, experience, and health statement. South America. Sj-5429.

Sales Engineering Service, graduate, prefer mineral dressing, metallurgy or mining, will consider chemical. Qualified by experience to analyze, plan, and carry to completion a sales program engineering services to the mineral industries. Should have a strong background in at least one of the following: sales of process equipment, contracting and construction of ore dressing plants, mineral process plant design, project engineering management. Will consider applicants who have sold manufacturers' process equipment to mining industries or who have sold engineering services. For engineering and manufacturing firm. Salary substantial. Base of operation in San Francisco, New York, Chicago, or Minnesota. Sj-5423-R.

Mill Foreman, considerable maintenance experience and with good knowledge of Pb-Zn metallurgy and amalgamation. Will be in charge of the mill during absence of mill superintendent and will be expected to keep mill books during that time. For new 500-tpd which will start up in the fall. $6000 to start. Colorado. Sj-5387.

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ELECTRIC PRECIPITATORS Excel in high efficiency, lowest

MECHANICAL COLLECTORS Shave-off cyclones provide superior

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CLASSIFIERS Capacity to keep up with any mill low power consumption, no moving parts

966 TRAXCAVATOR—2¾ CU. YD. STANDARD BUCKET • 140 HP Cat D333 Diesel Engine, turbocharged to give extra efficiency and quick response for machine drive and bucket hydraulics. • 57" reach at 7' dumping height . . . maximum lift—12' 10". • LIVE ACTION hydraulics for tough excavation, fast lift and dump. • DUAL-RATIO steering for work and highway travel. Operator shifts lever on steering column to select work or travel ratio. For work cycles and quick turns, one-half twirl of steering wheel puts Traxcavator in maximum turn. For travel ratio, 2 twists of wheel are required for sharpest turn. • DIRECT ELECTRIC STARTING standard. Gasoline starting engine optional.

CATERPILLAR ADDS 2¾ yd. and 1¼ yd. MACHINES

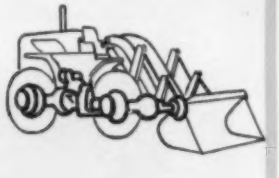
THE 966 and 922

Cat's first wheel loader, the 2 yd. 944, introduced this spring, has already gained an acceptance unmatched in machinery history. Now there's a full line and one for your job: the 966, 2¾ yd., 140 HP, for high production jobs where you measure time in tons of material loaded; the new 922, an 80 HP, 1¼ yd. Traxcavator with all the safety and fast operating features of the two bigger machines. The 922 can give you speed, versatility and production to handle all those jump-and-run jobs.

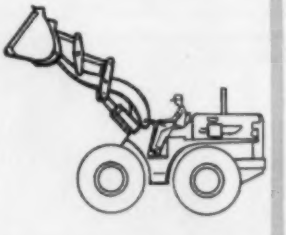
Have you seen a 944 working in your area? Have you asked the owner about its dependability and favorite features? He's probably got some mighty impressive answers. And frankly it's understandable why these Traxcavators have made a name for themselves so quickly. There is a *7-year* history of thorough testing and development behind these *new* machines. They come from the manufacturer with 23 years' loader experience and 20 years of wheel tractor know-how.

Look at the features that are on all 3 loaders: clean, open cockpit, easy to get into; bucket arms up front away from the operator; well-balanced design; long dumping reach (nearly 5' on the 966), soaring lifts to get over truck sides

Both the 966 and the 922 have all the features proved in the field by the popular 944 Traxcavator

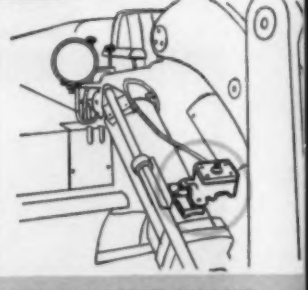


POWER SHIFT TRANSMISSION with torque converter gives smooth, instant shifting for 1st-2nd speeds—forward and reverse. In travel range, the machine is in 2-wheel drive for high-speed roading. A shift to work range automatically puts power to all 4 wheels for full traction.



OPERATOR SAFETY Lift arms and cylinders are all forward of the cockpit . . . giving complete freedom of movement. Visibility is excellent at all times. It's easy and safe to get into a Traxcavator from either side . . . up 3 wide steps . . . no ladders to climb. Tires are covered by fenders.

OPERATOR CONVENIENCE Bucket controls are on the right side, leaving the left hand free for machine operation. The forward-reverse lever is mounted on the steering column for finger-tip shifting without decelerating. steering is power boosted with dual-ratio on the 966.



AUTOMATIC BUCKET KICK-OUT DEVICE allows faster cycles. After loading bucket, pull lift lever to up position. Bucket goes up to dumping height and control kicks into hold position automatically. While lowering bucket after dumping, set tilt lever, and bucket is positioned for digging.

922 TRAXCAVATOR—1¼ CU. YD. STANDARD BUCKET • 80 HP. Your choice of compact 4-cylinder Caterpillar turbocharged Diesel Engine (uses low-cost furnace oil without fouling) or 6-cylinder gas engine with large cubic inch displacement for long life and sustained power. Use the type of engine that matches your other equipment. With either engine you have one source of warranty responsibility . . . one source of parts and service . . . your reliable Caterpillar Dealer. • Long 40¾" reach at 7' dumping height . . . maximum lift of 11' 2". • For top production in its class, the new 922 Traxcavator has all the safe, fast operating features of the bigger machines.

TO ITS WHEEL LOADER LINE...

TRAXCAVATORS

and railroad cars; automatic bucket controls to speed cycles; dependable Cat Diesel power with optional gasoline engines on two smaller models; Cat power shift transmission to change speed and direction with a finger touch, without decelerating; and service features like the dry-type air cleaner and unitized construction.

There's one man in your area with all the facts — your Caterpillar Dealer. Get in touch with him now. Ask for a demonstration — once you watch one of these machines you'll want it!

Caterpillar Tractor Co., General Offices, Peoria, Ill., U. S. A.

CATERPILLAR

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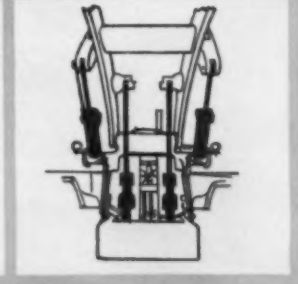
TRAXCAVATORS ARE MAKING OTHER LOADERS OBSOLETE

DUAL BRAKES The left brake pedal neutralizes the transmission as it stops the machine. This transfers extra power to the bucket . . . assuring full loads even in tough material. The right brake pedal stops the machine with the transmission engaged . . . giving full control for roading downhill.

EASY SERVICE ACCESS The seat tips forward for quick access to transmission oil filter and control linkage adjustments. Unit construction allows independent removal of engine, transmission, other major components. The dry-type air cleaner can be serviced in about 5 minutes.



LIVE-ACTION HYDRAULIC SYSTEM Plenty of power from the engine is always available to the husky vane-type pump that supplies the pressure and volume for fast bucket action. Control valves are enclosed in the steel reservoir for complete protection. System is full-flow filtered.

AVAILABLE WITH A COMPLETE LINE OF ATTACHMENTS, including special buckets for light or heavy materials, lift forks for lumber and palletized materials, and the exclusive side dump bucket. A fiber-glass cab is also available.

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Excavator manufacturers don't *have* to use herringbone gears. Some do. One of them is Marion. It boils down to just how literal a manufacturer is trying to be when he says "our machines have longer life." Marion knows, and so do discerning big-machine owners, that the unique design of herringbone gears does mean longer life in the truest sense. Smoother power flow too, with less vibration. More metal is in constant shear which means the unit is delivering total power at all times. Yes, it takes more machining operations to produce them. Yes, they're more expensive. But dollar for dollar, over the life of a Marion, such significant improvements as herringbone gears give you value received "plus." Just one more example of Marion quality in action for the big mining and quarrying jobs of the Sixties. Marion Power Shovel Company, Marion, Ohio, a Division of Universal Marion Corporation.

MARION

Mineral Information

An International Directory of Engineering Source Material

BOOKS

Order directly from the publisher all books listed below except those marked • • • The books so marked (• • •) can be purchased through AIME, usually at a discount. Address Irene K. Sharp, AIME Book Dept., 29 W. 39 St., New York 18, N. Y.

American Standard on Wire Ropes for Mines, M11-1960, *The American Standards Association*, 10 E. 40th St., New York 16, N. Y., 41 pp., $3, 1960—This is a revision of M11-1927 and is the result of the cooperative efforts of experts appointed to the M11-1960 committee by ten industry and government organizations, including AIME, American Mining Congress, ASME, ASTM, USBM, U. S. Bureau of Standards, and National Safety Council. The book covers everything that goes into the manufacture, testing, and safe use of wire rope in open pit and underground mines from "Abrasion (wear) on wire rope" to "Zinc, specifications for." • • •

Overvoltage Research and Geophysical Applications, edited by James R. Wait, *Pergamon Press, Inc.*, 122 E. 55th St., New York 22, N. Y., 158 pp., $9, 1960—Here are the results of a concerted effort to apply the overvoltage (or induced electrical polarization) phenomenon to geophysical prospecting, based on theoretical and experimental research done at Newmont Mining Co. laboratories. This monograph deals in turn with the basic concept of overvoltage, a mathematical description of the phenomena, phenomenological theory, laboratory results, and analyses of experimental data. Extensive field results are presented based on surveys in various parts of the world. • • •

Molluscan Fauna of the Flagstaff Formation, Memoir 78, by Aurele La Rocque, *Geological Soc. of America*, 419 W. 117th St., New York 27, N. Y., 100 pp., $4.50, 1960—A study of nonmarine mollusks of the western interior. La Rocque uses the record of animal life in the strata to interpret the changing environment and to determine the history of lakes from inception to extinction.

American Bureau of Metal Statistics for 1959, *American Bureau of Metal Statistics*, 50 Broadway, New York 4, N. Y., 140 pp., $4.50 hard cover, $4 paper cover, 1960—This 39th edition has been enlarged to include records for 1959 and prior years of mine production, smelter production, consumption, imports and exports, and other economic statistics on a worldwide basis. There are also introductory texts on the major nonferrous metals, reviewing the events of 1959; tables of metal prices, monthly and annual; lists of metallurgical plants and their capacities; general economic statistics of the U.S. and U.S. duties on principal ore and metal imports; and other extensive data, including tables of production statistics by companies, both domestic and foreign. This survey is compiled by the bureau, which is sponsored by the most important producers of copper, lead, and zinc in the U.S., Canada, Mexico, Chile, and Peru.

Optical Crystallography, 3rd ed., by Ernest E. Wahlstrom, *John Wiley & Sons Inc.*, 356 pp., $8.50, 1960—This review of basic principles avoids the mathematical approach. Space relationships are illustrated by two and three-dimensional drawings, many of them new in this edition. Elementary concepts are emphasized, with special attention to the use of the polarizing microscope, and a new chapter on crystal rotation methods. • • •

Crystals and the Polarizing Microscope, 3rd ed., by N. H. Hartshorne and A. Stuart, *St. Martin's Press*, 175 Fifth Ave., New York 10, N.Y., 557 pp., $17.50, 1960—This edition has been completely revised and expanded in the light of recent developments in the design of polarizing microscopes which have introduced new techniques in the study of crystal growth. New material has been added on the mechanism of crystal growth, on twinning, and on the methods and techniques of using the improved equipment. • • •

Beerman's All Mining Year Book 1960, *R. Beerman Publishers (Pty) Ltd.*, 76 Strand St., Capetown, South Africa, 481 pp., approx. $8.76 (£3.3s), 1960—Covers each metal and mineral mined in South Africa and South West Africa—its properties, its uses, where it is found, production figures, market. There is a general information section covering lease formula and mining taxation, South West Africa mining law, land measures, mining in Bechuanaland, mineral occurences in Swaziland, and Union Government mining publications. Indexes include alphabetical lists of metals, minerals, and mines, with details of 1000 mining companies. • • •

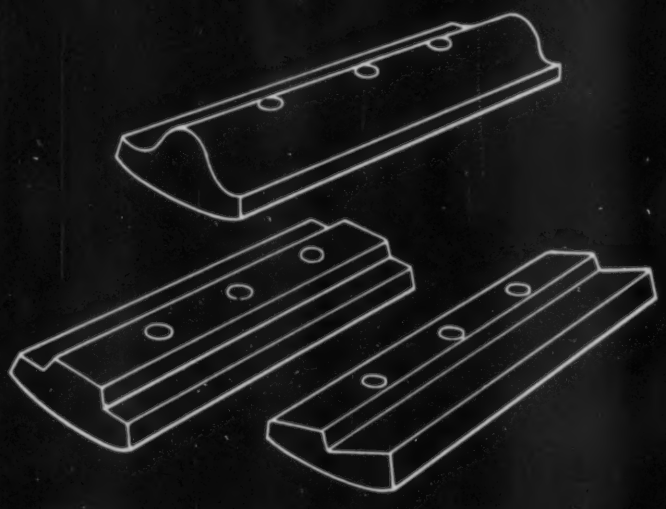
Mineral Economics and the Problem of Equitable Taxation, by Oscar H. Lentz, Spring 1960 issue of the *Colorado School of Mines Quarterly*, Dept. of Publications, Colorado School of Mines, Golden, Colo., 110 pp., $1, 1960—A critical study of the percentage depletion allowances for extractive industries is the basis of this work. It includes an analysis of the legislative rationale for depletion allowances, the concepts and principles underlying that rationale, and a presentation of the broad policy issues facing the Federal Government. The last chapter of the book is concerned with the problem of equitable state taxation of natural resource industries. In it the author takes exception to taxation methods recently advanced by other Colorado economists. He criticizes them for oversimplifying mine taxation cases —especially those who promote equalization of property taxes between mining and agriculture.

Quin's Metal Handbook 1959, compiled by Eileen Langford, *Metal Information Bureau Ltd.*, Birkett House, 27 Albemarle St., London W. 1, England, 640 pp., approx. $2.83 (£ 1.76), 1960—This 45th edition includes such new features as extracts from official Soviet Union foreign trade statistics, and a daily weighted average price for sales in Europe of electrolytic copper on a c.i.f. wirebar basis. Sections covering copper

(Continued on page 960)

BEAT ABRASION

With Calumet Permanent Mold NI-HARD* Mill Liners



Are grinding mill costs getting you down?

If they are there's a sure-fire method available to offset the ravages of abrasion—your greatest enemy.

Next time costly wear forces you to reline a rod or ball mill, install Calumet Permanent Mold Ni-Hard liners.

Regardless of what material you are reducing or whether your operation is wet . . . or dry . . . you're going to reap the benefits of longer liner life brought about because of the greater strength, hardness and resistance to impact that Calumet builds into its liner segments.

In Calumet Permanent Mold Ni-Hard liners you obtain two great features — the resistance to abrasion inherent in the patented alloying of nickel and chrome elements plus Calumet's own years of foundry experience, its casting know-how and metallurgical skills.

Talk over your grinding problems with Calumet. You'll find that Calumet engineers can help you establish new concepts of efficiency and economy. Don't put it off . . . do it TODAY!

**Reg. U. S. Pat. Off., Int'l Nickel Co., Inc.*

CALUMET DIVISION

Calumet & Hecla, Inc.

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BOOKS

(Continued from page 959)

brands and brands and analyses of tin, lead, and zinc have been revised and enlarged. The handbook is a comprehensive statistical survey of the ores, metals, iron and steel, and scrap industries containing price records, details of imports and exports, production and consumption, stocks, and brands. • • •

Metallurgical Society Has Books Available

Proceedings of technical conferences sponsored by The Metallurgical Society of AIME are now available in book form as published by Interscience Publishers in a uniform format.

Four titles are now available and additional volumes on recent and forthcoming conferences are in preparation. Volumes may be ordered from The Metallurgical Society of AIME, 29 W. 39th St., New York 18, N.Y., at a discount of 20 pct off list price to all AIME members in good standing.

Titles now available are: **Flat Rolled Products: Rolling and Treatment,** $3; **Reactive Metals,** $12; **Quality Requirements of Super-Duty Steels,** $6.50; and **Physical Metallurgy of Stress Corrosion Fracture,** $10.40.

Introduction to Solids, by Leonid V. Azaroff, *McGraw-Hill Book Co. Inc.*, 460 pp., $9.50, 1960—This study is based on the premise that "the one thing the majority of solids of practical importance have in common is that they are crystalline." The book concentrates on the structure, nature, and properties of inorganic crystalline solids, beginning with a thorough, although brief, discussion of elementary crystallography. Next the principles of quantum mechanics are considered in a very elementary way, and the results are applied to three kinds of solids: metals, semiconductors, and insulators. Mathematical complexity is kept to a minimum, introduced only when absolutely necessary to illustrate the principles involved. This text covers virtually all the important aspects of solid state and is useful to anyone interested in chemistry, ceramics, metallurgy, mineralogy, physics, and all engineering fields dealing with solid state. • • •

The Lead Smelting Mills of the Yorkshire Dales, by Robert T. Clough, a limited edition privately printed, available from the author *Robert T. Clough*, Stoneleigh, Utley, Keighley, Yorkshire, England. More than 150 pp. of text, $8.50 (60/—),

(Continued on page 963)

ASEA's new multi-rope friction mine hoists for installation in one of the largest mines take an unbalanced load of 55 tons at a speed of 2760 feet per minute—twice the load of any known hoist at this record speed.

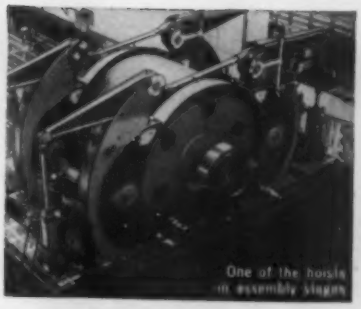
Here are two major advantages of these new mine hoists pioneered by ASEA for mine owners everywhere.

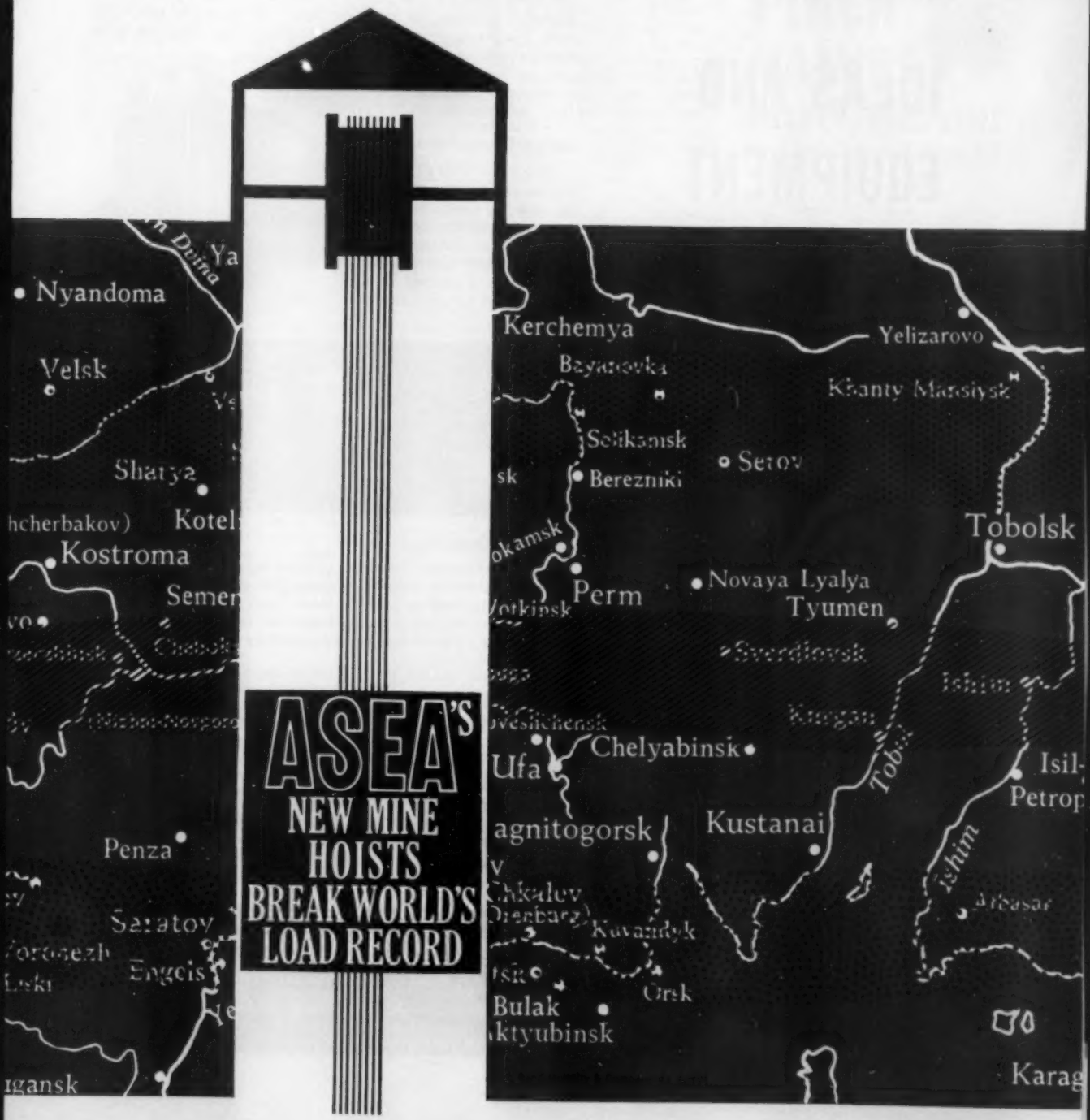
1 MULTI-ROPE FRICTION DRIVE; this enables a moderate sized pulley (length, 7'2", diameter, 12'2") to take a very high unbalanced load with ease.

2 FULLY AUTOMATIC OPERATION, which can save as much as $30,000 a year per hoist at prevailing U.S. wage rates, assuming two-shift operation.

Make profitable use of ASEA design and engineering experience. Let ASEA save operating costs—in a big way just as it saves for 14 U.S. and Canadian mining companies. Write for literature to: ASEA ELECTRIC INC. 500 Fifth Avenue, New York 36, New York and 55 New Montgomery Street, San Francisco 5, California.

TECHNICAL DATA			
Hoisting	Double Skip	Hoisting speed	2760 ft. per min.
Hoisting capacity	1400 tons per hour	Number of ropes	6
Net load	55 tons	Rope Diameter	1¾"
Skip weight	44 tons	Diameter of Pulley	12'2"
Depth of shaft	3940 ft.	Length of Pulley	7'2"
		Motor output	12,000 h.p.

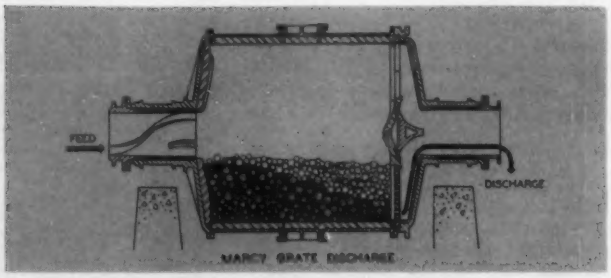

One of the hoists in assembly stages



imagination
to originate

experience
to produce...

IDEAS AND EQUIPMENT FOR LOWER COST GRINDING



Low Pulp Line

Mine and Smelter developed the principle of rapid change of mill content with a low pulp line obtained through use of grate discharge in Marcy ball mills and open end feature in Marcy rod mills. This Marcy principle increases tonnage up to 33%; decreases KWH per ton.

Large Diameter

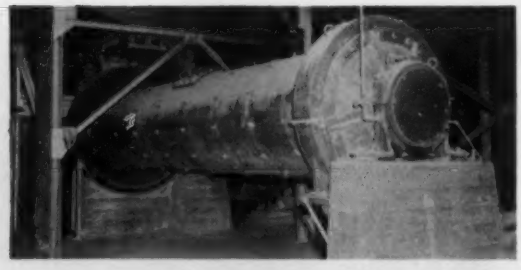
Mine and Smelter pioneered the use of large diameter mills to meet the need of specific applications where large tonnage per mill reduced initial cost, provided more efficient grinding, and resulted in a lower overall net cost per ton.

2-Stage Grinding

Mine and Smelter's research and experience has resulted in many refinements in the grinding process, one of the most significant being 2-stage grinding...adding Marcy Open End Rod Mills between existing crushing and grinding stages, or replacing fine crushing. This has proven to increase capacity, produce a better ball mill feed, and reduce overall costs.

MARCY MILLS

are available in 29 different diameter sizes, from 12" to 12'6"... all proven in the field...all built with mechanical specifications based on proven experience in the field.



Engineering for Special Applications

Engineering grinding mills for specialized applications requires the kind of imagination and experience which Mine and Smelter has developed during the 45 years it has devoted to the art of grinding. Shown is a Marcy Grate Discharge Ball-tube mill, with peripheral discharge, designed for dry grinding high-temperature calcined gypsum from 100 mesh to as fine as 5000 Blaine. This mill provides flexibility in fineness of grind and accurate, convenient means of control.

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BOOKS

(Continued from page 960)

1960—The first part of this book, which is a full survey of the buildings connected with early days of the industry, gives much unpublished information relating to lead mining and smelting methods, as well as the social life of the Yorkshire lead miner at the time. The book is copiously illustrated with line drawings, including original surveys, maps, and reproductions from Georgius Agricola's **De Re Metallica** of 1556, and photographs illustrating early mining techniques.

Mining Symposium Volumes Available from University of Minnesota

These Mining Symposiums date back to 1940, but the supply of *Proceedings* from 1940 through 1950 is exhausted. Also those of the 17th annual symposium, 1956, are unavailable. Those for the years 1951 through 1957 (with the exception noted above) are obtainable from The Center for Continuous Study, University of Minnesota, Minneapolis, Minn., at $2.50 apiece. The *Proceedings* for 1958, 1959, and 1960 are $7.50 each. Subjects covered in the Proceedings are:

Development and Use of Natural and Mineral Resources of Lake Superior District—1951.
Development and Use of Natural and Mineral Resources of Lake Superior District—1952.
Explosives, Blasting, and Problems of Iron Ore Flotation—1953.
Planning, Design, and Implementation of Large Extractive Ventures—1954.
Application of Aerial Surveys to Mining Engineering Problems, Soil Mechanics, and Lake Superior Iron Mining—1955.
Sintering, Pelletizing and Nodulizing—1957.
Scrubbing, Screening, and Stockpiling—1958.
Instrumentation and Controls in Mining and Beneficiation—1959.
Lake Superior Iron Ores and the American Economy—1960.

The Mining Journal Annual Review, 1960 Edition, *The Mining Journal Ltd.*, 15 Wilson St., Moorgate, London EC2, England, 350 pp., $3 (21/), 1960—This volume reports on the progress of mining throughout the world in both a technical and economic context. All recent developments in mineral exploration, mining, ore treatment, and refining are covered. It surveys the economic position of each metal, and the whole mining industry country by country, in the light of the latest trends. Of interest to mining investors are the progress reports of more than 150 of the principal mining companies in the Commonwealth.

Microscopic Sedimentary Petrography, by Albert V. Carozzi, *John Wiley & Sons Inc.*, 485 pp., $11.50, 1960—This book presents *ideal* descriptions of sedimentary rock-types as an approach to petrographic characteristics of a rock-type. An *ideal* description summarizes the most common appearances of a given rock-type and those variations which have broad significance. This description presents the reader with those essential features which are indispensable for a correct microscopic determination of a rock-type. In practice, the investigator will quickly and easily find enough similarities between the case he is studying and the *ideal* description to relate the one to the other. • • •

Rock Deformation, Memoir 79, by David Griggs and John Handin, *Geological Soc. of America*, 419 W. 117th St., New York 27, N. Y., 382 pp., $12, 1960—This volume contains 13 papers presented at a symposium on rock deformation, held at the Institute of Geophysics at UCLA, by theoretical and experimental leaders in the field. Gives results of recent work in experimental deformation and includes new theoretical contributions. • • •

FBI Register of British Manufacturers, 1960, 32nd edition, *Federation of British Industries*, 21 Tothill St, Westminster, London W.C.2, England, 1164 pp., $5.88 (42s), 1959. —A comprehensive and accurate guide to a substantial cross section of British industry, with lists of the products and services of over 7000 member firms under more than 5000 alphabetical headings.

Elements of Ion Exchange by Robert Kunin, *Reinhold Publishing Corp.*, 164 pp., $5.75, 1960.—Specifically written for those with little or no theoretical background in physics, this book provides a basic view of ion-exchange technology for executives, operating personnel, chemists, engineers, agronomists, and nuclear researchers. Most of the text is devoted to the fundamental theory of ion exchange—the nature of the materials involved, their structure, the techniques of testing and evaluation, and both general and specific principles of their application. Ion exchange engineering and design practice is also presented in a brief chapter. • • •

(Continued on page 964)

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- 1" to 14" inside diameter.
- Pressures to 150 psi.
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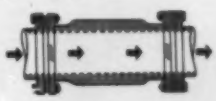
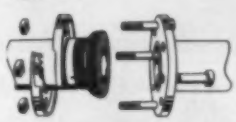
- Patented "hinged" sleeve. Recesses serve as "hinges" during compression; reduce strain and permit tight closing.

- Cannot leak or stick.
- No working parts in contact with pulp or liquid; no packing glands.



- Unobstructed flow eliminates high friction loss.
- Remote control available.
- Can be equipped for automatic regulation.



- Split flanges and patented Flex Seal ends assure perfect seal.

See Booth 302, American Mining Congress Las Vegas meeting, October, for latest advancement in valve automation.

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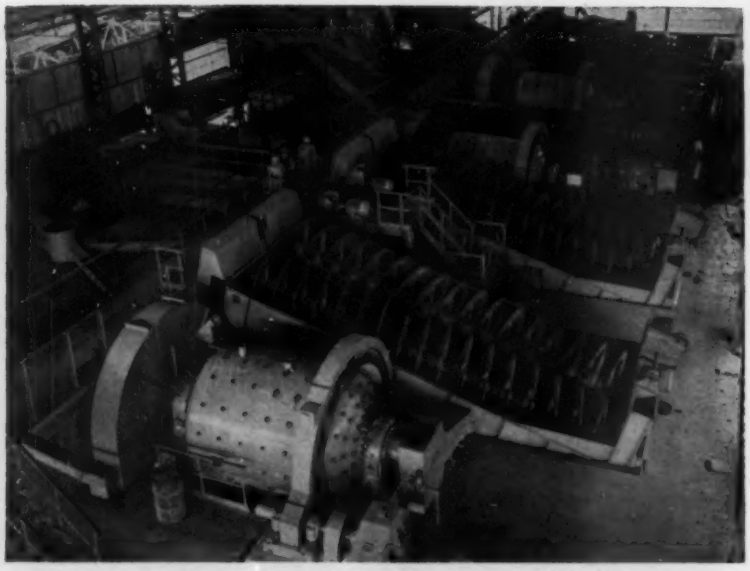
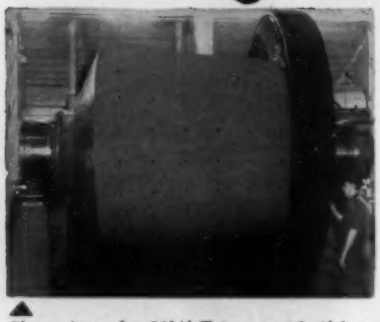


Shown here are four Hardinge 9-3-6-8 Tricone Mills grinding sulfide copper ores and mixed ores in a concentrating plant in the Belgian Congo, Africa.

CORRECT BALL SEGREGATION
in the
Hardinge TRICONE MILLS



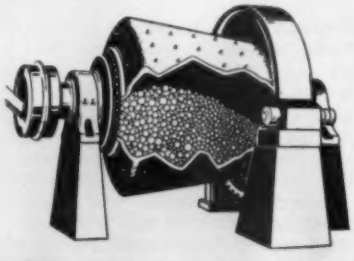
Shop view of a 10½' Tricone with 9' long tapered shell.

Highest grinding efficiency and lowest ball and lining wear are common to mills with a correctly segregated ball charge.

The Hardinge Tricone Mill is the only mill providing these essentials to low cost operation without the use of special linings or internal devices, which are subject to wear and are effective through only a part of their wearing life.

The Tricone also occupies less floor space for its grinding volume than any other ball mill built.

Every ball in the Hardinge Tricone Mill "minds its own business!"



Complete specifications upon request. Bulletin AH-414—2

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BOOKS

(Continued from page 964)

CANADA

Government Publications

Publications Distribution Office
Mines Branch
Dept. of Mines and Technical Surveys
Ottawa, Canada

Research Report R 17, Voltaic Cells in Fused Salts, Part 3, 25¢, 1958.
Research Report 1, Some Effects of Pressure on Consumable Electrode Arc Melting, 25¢, 1958.
Research Report R 20, Voltaic Cells in Fused Salts, Part 4, 25¢, 1958.
Research Report R 33, Recovery of Uranium from an Acid Leach Liquor, Using an Anion Exchange Resin and Sodium Corbonate and Bicarbonate as Eluting Agents, 25¢, 1959.
Research Report R 45, Some Analytical Applications of Solvent Extraction from Sulphate Solution with Long Chain Alkyl Amines, 25¢ 1959.
Research Report R 46, A Graphical Determination of Uranium and Thorium in Ores from Their Gamma-Ray Specta, 25¢, 1959.
Technical Bulletin TB 1, Combustion of Eastern Canadian Coal in Thin Fires on a Spreader-Fired Air-Cooled Oscillating Grate, 25¢, 1959.
Technical Bulletin TB 6, Relationship of Various Factors to the Quality of Coked Briquets Made from Mixtures of Coking Coals and Inert Material, 25¢, 1959.
Technical Bulletin TB 9, Briquetting Coal with Binders and Statistical Evaluation of Briquet Tests, 25¢, 1959.
Technical Bulletin TB 10, A Laboratory Study of the Binderless Briquetting of Western Canadian Coals, 25¢, 1959.
Technical Bulletin TB 11, A Viscomter for Mineral Suspensions, 25¢, 1959.
Technical Bulletin, TB 12, Radioactive Marking of Steel Balls for Grinding Tests, 25¢, 1959.
Information Circular IC 114, The Canadian Gypsum Industry, 25¢, 1959.
Metallurgical Works in Canada, Nonferrous and Precious Metals, Operators List 1, Part 2, 25¢, 1959.
Mineral Information Bulletin MR 34, A Survey of the Uranium Industry in Canada, 50¢, 1959.
Mineral Information Bulletin MR 35, A survey of the Petroleum Industry in Canada, 1957 and 1958, 50¢, 1959.

Queen's Printer
Ottawa, Canada

Production of Canada's Leading Minerals, August, No. 26-007, 10¢, 1959.
Products Made From Canadian Clays, August, No. 44-005, 10¢, 1959.
Iron Ore, September, No. 26-005, 10¢, 1959.
Coal Mining Industry, 1958, No. 26-208, $1, 1959.
Concrete Products, September, No. 44-002, 10¢, 1959.
Cement, September, No. 44-001, 10¢, 1959.
Coal & Coke Statistics, August, No. 45-002, 20¢, 1959.
Copper & Nickel Production, September, No. 26-003, 10¢, 1959.
Gold Production, September, No. 26-004, 10¢, 1959.
Silver, Lead & Zinc Production, September, No. 26-006, 10¢, 1959.
Preliminary Report On Coal Production, October, No. 26-002, 10¢, 1959.
Smelting & Refining Industry, 1958, No. 41-214, 50¢, 1959.

Manitoba

Dept. of Mines & Natural Resources
Winnipeg, Canada

Bibliography of Geology of the Pre-Cambrian Area of Manitoba, Publication 57-3, gratis, 1959.
Bibliography of Geology, Paleontology, Industrial Minerals, and Fuels in the Post-Cambrian Regions of Manitoba 1950 to 1957, Publication 57-4, gratis, 1959.
Gypsum-Anhydrite Deposits of Manitoba, Publication 58-2, gratis, 1959.

Ontario

Publications Office
Dept. of Mines
Toronto, Canada

Ontario—An Expanding Mining Empire, Annual Report of the Department, 1959, gratis, 1960.

(Continued on page 966)

Gardner-Denver GD10 mine car loader

Crowd in and muck out faster— Gardner-Denver Mine Car Loaders

POWERFUL—unmatched for speed—exclusive fulcrum design coupled with powerful dipper motors assures fast, *full* loading.

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BOOKS

(Continued from page 964)

Geology of the Saganash Lake-Wakusimi River Area, gratis, 1960.
Ground Geophysical Map of Balmer Township, uncolored print, $1, 1960.
Geological Map 1960 of Methuen Township, gratis, 1960.
Preliminary Geological Map of Nairn and Lorne Townships, uncolored print, $1, 1960.
Preliminary Geological Map of Porter and Baldwin Townships, uncolored print, $1, 1960.
Aeromagnetic Map of Nikip Lake, 899G, 25¢, 1960.
Aeromagnetic Map of Windigo Lake, 898G, 25¢, 1960.
Aeromagnetic Map of Shinbone Lake, 897G, 25¢, 1960.
Aeromagnetic Map of McCauley Lake, 896G, 25¢, 1960.
Aeromagnetic Map of Whitestone Lake, 895G, 25¢, 1960.
Aeromagnetic Map of Cat Lake, 894G, 25¢, 1960.
Aeromagnetic Map of Zion Lake, 893G, 25¢, 1960.
Aeromagnetic Map of Wesleyan Lake, 892G, 25¢, 1960.
Aeromagnetic Map of Otatakan Lake, 891G, 25¢, 1960.
Aeromagnetic Map of Anenimus River, 890G, 25¢, 1960.

ABSTRACTS

In This Issue: *The following abstracts of papers in this issue are reproduced for the convenience of members who wish to maintain a reference card file and for the use of librarians and abstracting services. At the end of each abstract is given the proper permanent reference to the paper for bibliography purposes.*

Controlling Fires in Mines with High-Expansion Foam by *John Nagy, Edwin M. Murphy,* and *Donald W. Mitchell*—By use of proper techniques, enough water can be carried by foam to control fires of moderate intensity. The proper techniques and necessary equipment are discussed, and general considerations for applying the method in mines are reviewed. **Ref.** (MINING ENGINEERING, **September 1960) p. 993.**

The Bowers-Campbell Mine by *Larry G. Hayes*—Development of the Bowers-Campbell zinc deposit, located in the Shenandoah Valley in Virginia, was commenced in 1956 by Tri-State Zinc Co. The occurrence of Pb-Zn mineralization in this area has been known for many years, but the first serious exploration program was initiated in 1951 by the company's geologic staff. The orebody features an unusual spiral-shaped access-haulage adit admirably suited to this deposit. Ore is mined by open-stoping utilizing the basic room-and-pillar method. **Ref.** (MINING ENGINEERING, **September 1960) p. 997.**

The Digital Computer—Applications in Mining and Process Control by *Peter B. Nalle* and *Leroy W. Weeks*—The rapid growth of the modern electronic computer industry has been one of the great phenomena of American business, if not of our entire economy, during the last 15 years. As in other industries, computers are becoming more common in the field of mining. For those interested in the possibilities of computer analysis and control the question is, "Where can a computer system be of use in my mining operation today?" Some ideas of such applications are given in the article, as well as a specific example of computer control at the Riverside Cement Co. **Ref.** (MINING ENGINEERING, **September 1960) p. 1001.**

Data Processing by Machine—Asset at the Mine Site by *George S. Koch, Jr.* and *Richard F. Link*—Mine processing of data has been successfully applied to one specific phase at two hard-rock mining operations in Mexico. The speed, efficiency, and adaptability of such machines can be of assistance in modernizing similar operations elsewhere. This article presents a case history of the operation at the two mines. **Ref.** (MINING ENGINEERING, **September 1960) p. 1005.**

Engineers Joint Council Mission to Russia—A report on results of a tour of Russian institutions. **Ref.** (MINING ENGINEERING, **September 1960) p. 1008.**

Automatic Thickener Control at Marmora by *W. M. Aubrey*—At this operation the pellet plant demand and the concentrator are not usually equal. To counter this problem, surge capacity in the form of storage pits in combination with a 30-ft diam thickener has been provided between the concentrator and the pellet plant. Two sets of controls have been installed on this thickener, one controlling the feed to the thickener and the other, the underflow removed from the thickener. The article gives a detailed description of the thickener control and its operation. **Ref.** (MINING ENGINEERING, **September 1960) p. 1009.**

Bucket Wheels in Germany by *Guenther Linden*—A series of interesting photographs of large and small bucket wheels. The four elements of bucket wheel excavation and transportation of material from open pit to dumping area are also shown. **Ref.** MINING ENGINEERING, **September 1960) p. 1013.**

SME Meeting Papers: *The following abstracts of papers presented at SME meetings are given for your information. Preprints of these papers are not available.*

Uses of Photogrammetric Mapping and Aerial Photo Interpretation by *Leonard H. Delano*—Photogrammetry, the science of measuring the earth's surface from precision stereoscopic aerial photos and of deducing information from photos of an area, is constantly expanding its usefulness. Photogeology and other forms of photo interpretation detect and evaluate information from subtle evidence not visible to earth-bound men. Landforms, vegetative soil evidence, drainage patterns, lineament and fracture evidence show up on photos or assemblies of them. Much needs to be done in the Pacific Northwest, Alaska, and other western areas. Examples of the type of work helpful to this group are stero-templets and other control extension methods for mapping, soil studies and classification, evaluation of landforms and other evidence for mineral and petroleum potential, uses of color photography in geology, and numerous other mapping and photo interpretation procedures. *AIME-ASM Pacific Northwest Metals and Minerals Conference, Portland, Ore., April 1960.*

Research at Pacific Power & Light Company in the Natural Resource Field of the Northwest by *James B. Ward*—Pacific Power & Light Co. shares with the AIME a vital interest in the development and growth of the metals and minerals industry in the Pacific Northwest. In the face of the ever-increasing pace and rapidly expanding scope of advances in science and technology, Pacific Power early last summer established a new research department for the purpose of evaluating these technological developments in terms of the company's position and for the purpose also of fostering beneficial development of resources and potentials existing throughout its service area. The research effort is being implemented in the form of an interdisciplinary team of specialists in various fields, with the intent of utilizing laboratory facilities and additional brainpower of universities, research institutes, and similar resources to carry out the various projects selected for attention.

At present, work is in progress in fisheries research, studies of nuclear power, and investigations of coal and other mineral resources. *AIME-ASM Pacific Northwest Metals and Minerals Conference, Portland, Ore., April 1960.*

Recent Developments in the Mining Laws by *Irving Rand*—Two mining laws—Public Law 585 of Aug. 13, 1954, and Public Law 167 of July 23, 1955—are reviewed. These acts were hailed by their sponsors as a great social advance and as a liberalization in the use of the public domain. But fundamentally these laws, particularly Public Law 167, are but another step toward retention of governmental ownership, control, and operation of the public lands. Their administration will inevitably result in fewer and smaller additions to private ownership, and in more and more totalitarian or communal land ownership in this country. Secondly, these laws have the defects of vagueness, which makes for finality in administrative as opposed to impartial judicial determinations. Such phrases as "common varieties" and "vegetative surface resources" in Public Law 167 lend themselves to such varied interpretation as to elude judicial control, and in effect make government administrative officials final arbiters and practically sole controllers of the mineral resources of the public domain. *AIME-ASM Pacific Northwest Metals and Minerals Conference, Portland, Ore., April 1960.*

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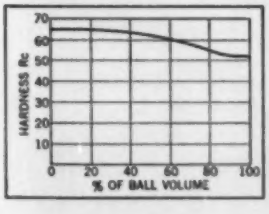
If an emergency, or your need requires, your order for USS Grinding Balls can be processed and shipped in a matter of hours. A complete stock program assures a full range of sizes, ¾″ to 4″, in USS Carbon-Manganese and USS Alloy Steels. There are many good reasons for buying USS Grinding Balls among which are: **Maximum hardness** combined with superior toughness. **Deeper hardness penetration** achieved by careful combination of chemical compositions and heat treatment. **Uniform roundness** from ball to ball, load to load, for less wear and superior performance.



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MANUFACTURERS NEWS

NEWS / EQUIPMENT / CATALOGS

ITV

Use of closed circuit television within the mining industry is growing. Recently, the *General Electric Co.* developed a self-contained, single-unit transistorized camera designed to function at top efficiency under extreme conditions of vibration and noise. Enclosed in a rugged,

dust-tight housing, the "Vidicon" unit weighs 9 lb, is 11¾ in. long with a 5½-in. diam. Reportedly very mobile, the unit operates on a power input of 18 watts, is protected from outside electrical interference, and does not require any ventilation. **Circle No. 1.**

Coal Conveyor Belting

The *Thermoid Division* of *H. K. Porter Co.* has designed a new conveyor belting which is impregnated with Polyvinyl chloride to increase toughness and durability to the individual strands. Called "Plasticoal" belt, it is specifically for use in underground coal mines. Composed of double nylon cords and cotton cords woven through the belt in both directions to insure greater strength and extra conveying surfaces, the belt features better material traction, controlled belt stretch, and maximum resistance to abrasion, tearing, and rot due to moisture and mildew. Approved by the U. S. Bureau of Mines, the belting is lightweight and flexible for ease of handling. **Circle No. 2.**

Rock Drill

A compact push-feed rock drill which can be manipulated into any position by handle-grip controls has been introduced by *Thor Power Tool Co.* The Model 330 drill can be raised and lowered without requiring the operator to remove his hand from the handle grip. The unit is available with manual or power-retracted interchangeable feed legs. In addition, the drill can be locked in line with the feed leg for use as a stoper or for roof-bolting operations if desired. **Circle No. 3.**

Electrical Ground Detector

The "Faultfinder," a combination ground detector and fault finder capable of locating accidental grounds quickly without requiring the shutting down of operations, has been developed by the *Parr Mfg. Co.* The unit weighs only 18 lb and contains a cabinet, exploring cord and extension pole. **Circle No. 4.**

Vibrating Screens

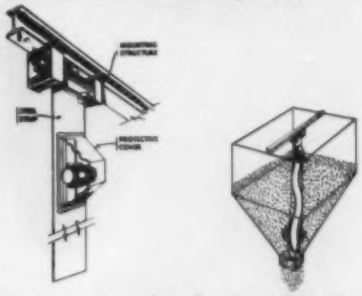
The W. S. Tyler Co. has introduced a new line of vibrating screens designed for ruggedness and durability at an economical cost. Termed "Ty-Rocket" screens, they are supplied without a supporting base and are of modular design. Both factors contribute to the low initial cost without affecting the strength and quality standards. For screening coal, ores, limestone, sand and gravel, the Ty-Rocket will be available in standard sizes from 3x6 ft to 6x16 ft in one, two, or three decks. **Circle No. 5.**

Underground Loader

The Eimco Corp. has designed an underground loader to replace the Eimco 21 RockerShovel. Designated the "Eimco 24", this unit incorporates the new replaceable rail design, involute rail thrust ends, improved bucket discharge and expanded range of discharge heights, greater bucket capacity, and increased digging force with provision for digging below depth of rails. All existing Eimco 21's can be converted to the new model. **Circle No. 6.**

Internal Bunker Vibrators

To maintain the free flow of materials from wood, steel, or concrete bunkers, *Syntron Co.* has developed internal bunker vibrators. The unit consists of an electromechanical rotary vibratory mounted on top of a long steel strip and suspended inside the bunker directly above the



discharge opening. In operation, the vibrator causes the steel strip to undulate violently, breaking down any arched or plugged zones. The vibrator supports a 5-ft steel strip, 18 to 24 in. wide, but added lengths of steel can extend the strip to a maximum of 50 ft. The unit operates on a 220 or 440-v, 3-phase, 60-cycle, a-c power. **Circle No. 7.**

News & Notes

Lake Shore, Inc., of Iron Mountain, Mich., will establish a wholly-owned Canadian subsidiary named *Lake Shore Marine and Mining Co. Ltd.*, in Toronto. B. W. Reeve, president of *Lake Shore*, said the new company plans to manufacture both mining and marine auxiliary equipment in Canada for Canadian markets . . . . *Swecomex, S. A.*, a new Mexican company which will design and manufacture heat exchangers, pressure vessels, and other related equipment for the Mexican process industries, has announced the formal opening of its new $2 million plant in Guadalajara. Minority interest in this firm is held by *The Anaconda Co.* and the *Southwestern Engineering Co.* . . . . *American Potash & Chemical Corp.* has announced its plans for building a $5 million electrolytic manganese metal manufacturing plant at Aberdeen, Miss. Initial plant capacity is slated to be 10 million lb per year . . . . The *Geophysical Instrument Co.*, formerly a division of *Georator Corp.*, is now a separate corporation. Its offices, laboratory, and manufacturing facilities will remain in Manassas, Va. *Joy Mfg. Co.* has purchased the assets of *Compton Inc.* of Clarksburg, W. Va., manufacturers of earth and coal augurs.

(21) CRUSHERS: *The Pennsylvania Crusher Div.* of *Bath Iron Works Corp.*, recently issued bulletin 4020 describing the complete line of crushers available from the company. This 16-page booklet illustrates and briefly describes each type of crusher in the *Pennsylvania* line, and indicates typical applications. It serves as a good guide to preliminary crusher selection and is a guide to more detailed bulletins on specific crushers.

(22) HARD ROCK DRILL: *Gardner-Denver Co.* recently issued a single page bulletin, 6-6ee, describing its Mole-Dril model AM4A which is attached directly to a drill pipe in place of the conventional rotary bit. It is designed for hard rock drilling in the construction, quarry, and mining industries.

(23) LIQUID-SOLIDS SEPARATION: Catalog FP-1003 recently released by *The Eimco Corp.* describes the company's complete line of liquid-solids separation equipment for chemical and metallurgical processing. This four-page catalog contains brief descriptions and pictures of all Eimco equipment for vacuum and pressure filtration, for sedimentation and flotation clarification, and for water and trade wastes treatment.

(24) MATERIAL CRUSHING MANUAL: *The Pennsylvania Crusher Div.* of *Bath Iron Works Corp.* recently issued a new edition of its "Handbook of Crushing". This 40-page book has been prepared to provide a better understanding of the entire subject of mechanical size reduction. The various reduction methods—impact, attrition, shear, and pressure—are described and discussed, as are the many kinds of crushing equipment. The various factors to be considered in selecting crushing methods for particular applications and materials are also covered. The book is supplemented by diagrams and charts.

FREE LITERATURE

(25) SHAFT MUCKER: An illustrated four-page leaflet from *Shaft & Development Machines Inc.* describes two air-powered Cryderman shaft muckers for vertical and incline shaft mucking. A table of specifications on each machine is included in the brochure.

(26) DRUM HOISTS: Catalog AC 6002, a 20-page booklet from *Vulcan Iron Works Co.*, illustrates and describes a wide variety of *Vulcan-Denver* mine and utility hoists. The special uses of specific models are listed with tables of specifications.

(27) SCREW WASHERS: Technical bulletin SW-80 issued by *McLanahan & Stone Corp.* describes a new series of single and double screw washers. Significant design refinements include improved direct drive, more efficient control of fines, and modified rear gudgeon construction. Construction and design data, capacities, and dimensional drawings of the new screw washers are included in this eight-page bulletin.

(28) NONMETALLIC MINING EQUIPMENT: Equipment designed to increase automation in the nonmetallic mining and manufacturing industry is the subject of the four-page bulletin G-11 issued by *Fuller Co.* The booklet summarizes the capabilities of ten different types of mining and processing equipment made by the company, and accompanying each description is the number of a special product bulletin which discusses the equipment in greater detail. These supplementary bulletins are available from the company on request.

(29) AUTOMATIC SAMPLER: *Hardinge Co. Inc.* has issued a revised eight-page catalog (No. 47-A) describing its re-designed automatic sampler. Photos and diagrams illustrate in detail the new operating mechanism of the sampler and typical arrangements for both wet and dry processes. Dimensions and parts identification, parts list, and sampling formulas are included. The sampler takes periodic cuts from a stream of moving material, wet or dry, at any stage in the continuous flow process.

(30) VIBRATING FEEDERS: Folder 2770, a six-page leaflet issued by *Link-Belt Co.*, describes the company's new Straightline vibrating feeders which incorporate a new principle of vibration for high-capacity, controlled feeding of heavy and highly abrasive bulk materials. These materials include iron and nonferrous ores, coal, rock, slag, shale, clinker, gravel, and foundry sand. The booklet is illustrated and contains a specification table.

(31) CRUSHER: *Nordberg Mfg. Co.* has released a four-page bulletin which describes its full range of Symons Primary Gyratory Crushers. Charts, graphs, and photographs are used to show important design features, selection data, dimensions, screen analysis, capacities, and operating data. A single set of drawings plus a simple size chart with critical dimensions are included.

(32) CRAWLER TRACTORS: The Eimco 103 Crawler-Tractor line is well-described in bulletin L-1097 from *The Eimco Corp.* The features and advantages of the "103" series are discussed, and the specifications of each member of this line are presented. In addition to the large amount of detail supplied, the 30-page booklet also includes photographs and engineering drawings of each unit plus several cut-away views of the tractors.

mail this post card for more information

9

Mining Engineering **29 West 39th St.** **New York 18, N. Y.**

Not good after December 15, 1960

Please send { More Information ☐ Price Data ☐ Free Literature ☐ } on items circled.

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51	52	53	54	55	56	57	58	59	60
61	62	63	64						

Students should write direct to manufacturer.

(33) CONTINUOUS PROCESSING: A new revision of the 16-page brochure entitled "Continuous Processing" (bulletin No. 7004) illustrates and lists the distinguishing characteristics and applications of 55 types of continuous processing equipment manufactured by *Dorr-Oliver Inc.* Pilot plant equipment in also described, with special emphasis on classification, centrifuging, filtration, and fluidization.

(34) TRAXCAVATOR: *Caterpiller Tractor Co.* has issued a two-color eight-page booklet describing its model 977H Traxcavator. Features of new unit include a turbocharged engine, a new power shift transmission coupled with a speed range selector to give four speeds forward or reverse, a new dry-type air cleaner, and a hydraulic system producing 27 pct greater pry-out force than earlier models.

(35) METAL FLOORING AND STAIR TREAD: Steel and aluminum flooring and stair tread are the subjects of bulletin 50-9 from *Joseph T. Ryerson & Son Inc.* This 12-page illustrated brochure covers both solid and open type flooring and tread in a number of patterns and openings and in material with slip-resistant surface. Plate and panel sizes, strength data, plus design, specification and installation information are also supplied.

(36) TRANSITE UNDERDRAIN PIPE: A four-page folder recently published by *Johns-Manville Co.*, describes the use of Transite Underdrain Pipe in sub-surface drainage systems for highways, airports, flood control projects, plant sites, and similar projects. Photos, diagrams, and tables are used to illustrate installation and assembly of the pipes; determination of hole sizes, distance between holes and method of perforation for the various sizes of pipe; and the minimum crushing strengths of the pipes.

(37) PROJECT ENGINEERING SERVICES: A handsomely illustrated 12-page brochure, bulletin No. 8010 recently issued by *Dorr-Oliver Inc.*, describes the company's services in the development of complete plants in locations around the world. These services include laboratory testing, pilot plant demonstration, flowsheet preparation and engineering studies, cost estimates, plant design and specifications, purchase of equipment, supply of complete plants, erection and construction, supervision of initial operation, and training of plant personnel.

(38) FEEDERS AND ROTARY VALVES: *Fuller Co.* has recently issued bulletin F-5A which describes and illustrates its complete line of roll and vane-type feeders and rotary valves. The feeders are designed to handle dry pulverized and granular materials. The bulletin includes photographs and drawings of the feeders as well as five tables with key dimension and capacity figures for each unit.

(39) CONDULETS: A 20-page brochure entitled "Condulets for Corrosive Locations" has been reissued by *Crouse-Hinds Co.* as bulletin 2699. Corrosive substances are listed in tabular form with appropriate corrosion-resistant metals and finishes used in Crouse-Hinds condulets. The booklet also contains brief descriptions of the metals and finishes, and includes listings of "Plast-A-Coat" condulets for hazardous and non-hazardous locations.

(40) SCREW CONVEYOR DRIVE: *Link-Belt's* new standard double reduction shaft-mounted speed reducer drive for direct application to screw conveyors is the subject of the four-page bulletin 2718. This speed reducer is available in six sizes with ratios of 15:1, 20:1, and 24:1 for motors up to 30 hp. The folder lists the sizes available in relation to screw diameters and gives selection data.

(41) GAS MASKS: An industrial gas mask canister selector-table, listing the 62 most common industrial gas and vapor hazards, is included in the latest flyer from *Willson Products Div.* of *Ray-O-Vac Co.*, manufacturers of respiratory protection equipment. Opposite each hazard are listed the recommended canister, a color guide, and U.S. Bureau of Mines approval where applicable. The flyer shows the full line of respiratory equipment including lens properties, canister numbers and sizes, laboratory approvals, sizing, fitting, and product descriptions. Individual components and carrying cases are illustrated and explained.

(42) RECIPROCATING PUMPS: Complete information on its 25 to 2400 hp direct flow pumps is contained in bulletin 100 from the *Aldrich Pump Co.* Featured in this four-page, two-color folder are the Aldrich triplex, quintuplex, septuplex, and nonuplex reciprocating pumps. Also described is the Aldrich-Groff "Power-Savr" pump. Designed for quick reference by engineers, production, and management personnel, this condensed catalog includes design and material specifications, dimension tables, and a pump selection chart for the complete Aldrich line.

(43) ENGINES: Pamphlet CR-764-K issued by *International Harvester Co.* describes 27 diesel and carbureted engines now available from the company. This three-color brochure illustrates each engine and includes specification tables for both the diesels and the carbureted models. The engines weigh from 279 lb to 6,045 lb with hp-ratings ranging from 16.4 to 385.

(44) POWER SHOVEL: A 12-page catalog from *The Thew Shovel Co.* describes the 1-yd crawler-mounted Lorain model 50. The two-color booklet gives details of the machine's construction and job applications. It is designed for use as shovel, crane, hoe, clamshell, or dragline.

(45) ONTARIO MINING HISTORY: The fourth edition of "Ontario's Mineral Heritage", a synopsized story of the development of the mining industry in that Canadian province, is now available. Of popular interest, the 28-page booklet is completely up-to-date, and it is profusely illustrated and supplemented by graphs and maps. The booklet contains much general information and will serve as a useful reference to this area. If interested, write directly to the Ontario Department of Mines, Parliament Building, Toronto.

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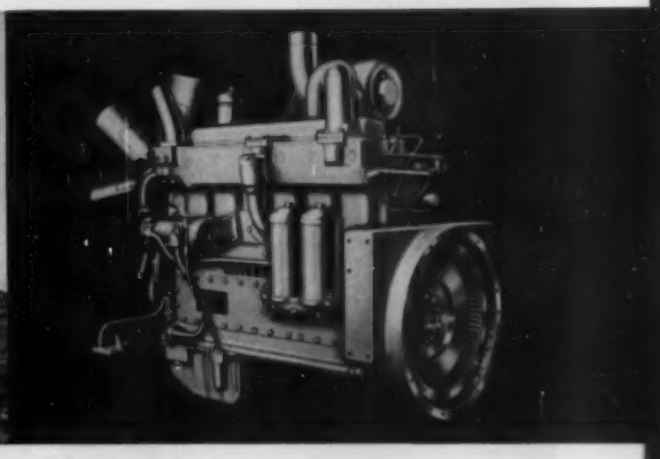
NEW CAT NO. 14 SERIES C MOTOR GRADER

Compact engine plus many other refinements assure top performance, easier servicing, long life



Important changes make up the new Series C No. 14 Motor Grader—big improvements throughout to give you better performance, long life and servicing ease:

NEW COMPACT 150 HP ENGINE The short, rigid block and stress-relieved crankshaft give greater strength and shock resistance. New cylinder head design resists distortion yet has superior cooling characteristics. Large water pump with cast-iron impeller, ceramic seal face, and carbon type seal combined with a 20 per cent increase in radiator capacity improves cooling, lengthens life.

NEW STARTING ENGINE All-weather starting with this new two-cylinder vertical gasoline engine is assured. Replacing the horizontal engine, this design features aluminum pistons and overhead valves for improved performance. Bore is 2.38″, stroke is 2.38″, and compression ratio is 8:1. Over-running clutch in starter pinion prevents damage to starter engine when diesel starts, a year-round starting plus.

NEW SERVICING EASE An advanced fuel system is designed for easier servicing and more efficient operation. Compact fuel injection pumps with barrel and plunger assemblies enclosed in housing help reduce wear, lengthen service life.

Plus all the features that made the No. 14B the most versatile motor grader in the "big machine" field . . .

EXCLUSIVE OIL CLUTCH—provides up to 2000 hours of service without adjustment, equal to about a year of "adjustment-free" operation.

DRY-TYPE AIR CLEANER—removes 99.8 per cent of all dirt from intake air. Can be serviced in five minutes.

MECHANICAL CONTROLS—provide easy engagement. "Anti-creep" lock makes blade stay put under load.

FULL VISIBILITY—operator has unobstructed view of job even while seated.

Now, all Cat Motor Graders feature the compact engine. Like the new No. 14C, the 85 HP No. 112E, the 100 HP No. 112F, and the 115 HP No. 12E are all designed to give you the highest production at the lowest possible cost. Your Caterpillar Dealer can give you the facts and figures. He can prove it both on paper and on your job. Call him today.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

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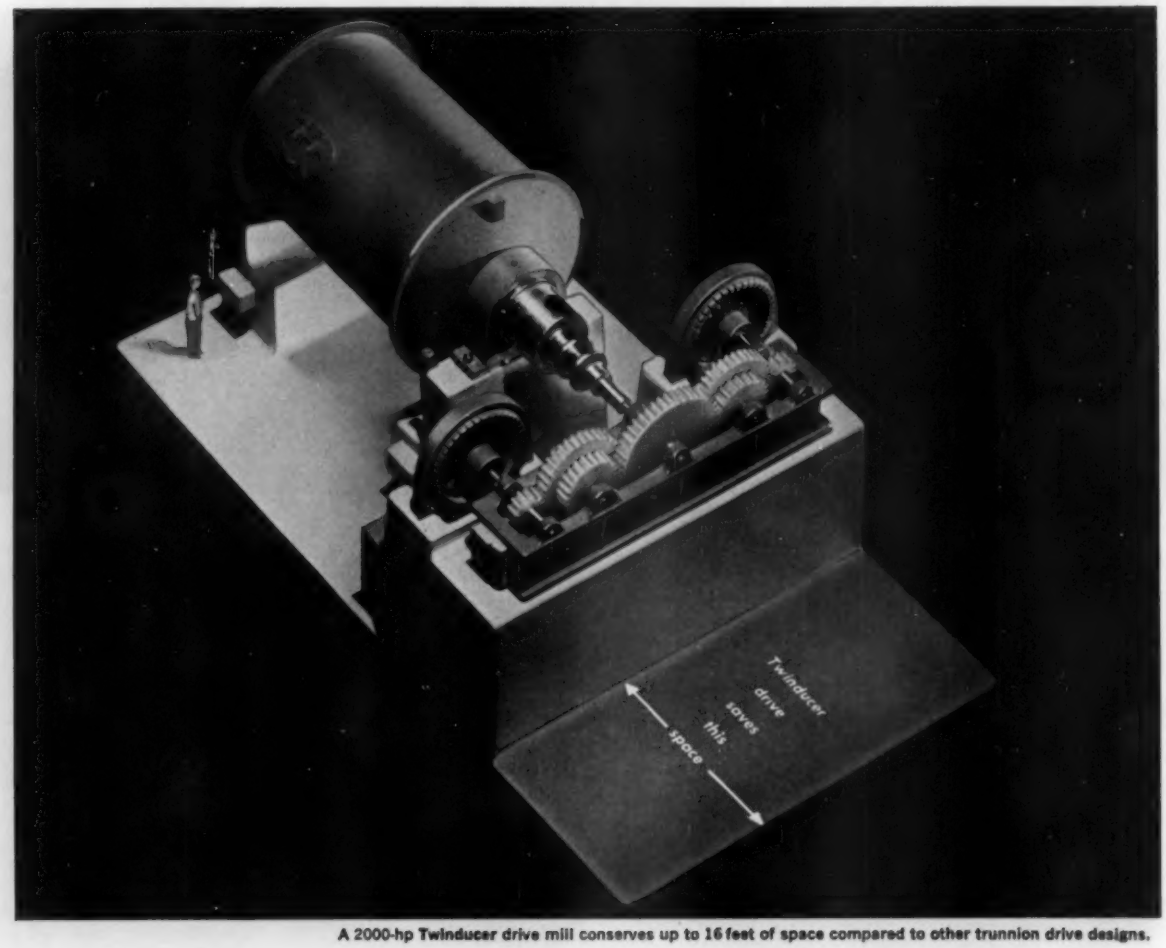
THE NEW NO. 14C
MOTOR GRADER—
MADE FOR THE BIG JOBS

ALLIS-CHALMERS



A 2000-hp Twinducer drive mill conserves up to 16 feet of space compared to other trunnion drive designs.

Twinducer drive saves on space and wear...

divides mill loads electrically

Another Allis-Chalmers first — *Twinducer* drive mill — creates new space savings, new long-range operating and maintenance economies.

Dynamic electrical load distribution is accomplished through rotor shift of one of the two motors. Once the load is balanced and the rotor locked in place, there is no need for further adjustment. No need for a floating gear or pinion, either, since electrical, not mechanical, balancing is employed with *Twinducer* drive.

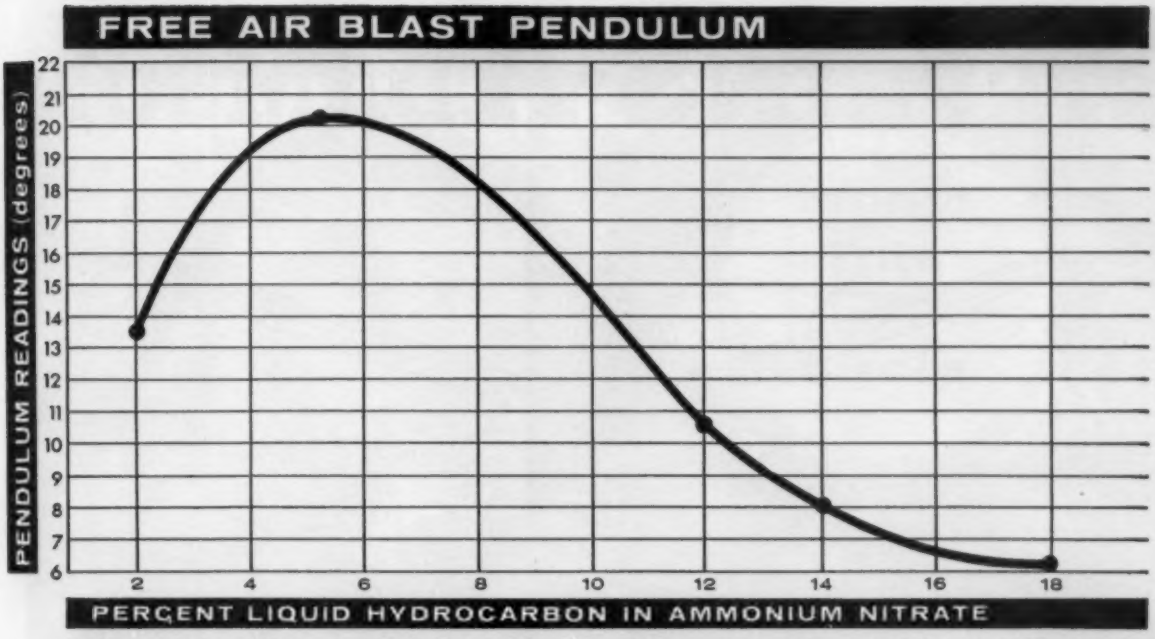
Gears and pinions experience less wear because they are fixed. Wear is further reduced because the gear train runs in a filtered oil bath, promoting longer gear life through both splash and flood lubrication.

Twinducer drive efficiently harnesses the power of *two* synchronous motors located on the mill side of the drive. This unique, compact arrangement reduces drive dimensions drastically . . . as much as 16 feet on a 2000-hp drive.

Twinducer drive promotes better housekeeping, too. No lubricant leakage because the system is enclosed. No oversized foundations, no pits to collect waste materials and dirt.

Ask your A-C representative about the outstanding features of Twinducer drive mills. **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wis.*

Twinducer is an Allis-Chalmers trademark. A-1365



As this graph shows, blast output is closely related to the amount of fuel oil absorbed by the solid material. If it is too dense, too little fuel oil is absorbed and optimum blast energy cannot be released. Spencer N-IV has a special structure which allows it to absorb fuel oil more evenly and completely and release greater blast energy.

Why Spencer N-IV And Fuel Oil Deliver Greater Blast Output Than Higher Density Materials:

Because it soaks up fuel oil better, Spencer N-IV gives more blast energy than higher density, non-absorbent material

Do higher density materials really produce more blast energy? No, say blasting experts.

Actually, the opposite is true. When higher density material is used, the net result is really lower blast output. According to *Military Explosive*, published by the Department of the Army:

> **"The sensitivity of ammonium nitrate to initiation decreases with increase in loading density. If the density exceeds 0.9 charges of 1 to 3 pounds cannot be detonated completely by large booster charges, and larger quantities cannot be detonated completely at densities greater than 1.1."**

The reasons for this are clear. When a higher density, non-absorbent material is used, the outer layer of the particle is coated with too much fuel oil. This retards the efficiency of the explosion when the blast begins.

In addition, the inner layers of the higher density material don't get enough fuel oil. The mixture is too lean so that maximum blast energy cannot be released.

According to extensive research investigations, Spencer N-IV, when mixed with the recommended 6% fuel oil, delivers 20% to 25% more blast energy than equal charges of other solid ammonium nitrate-fuel oil mixtures. There are two main reasons for this:

1. Lower density which provides greater ease of detonation.

2. Special prill structure which allows fuel oil to be absorbed more evenly.

Many other prilled ammonium nitrates have coatings of diatomaceous earth. This coating tends to absorb more fuel oil on the outside of the particle. It reduces the distribution of oil within the particle.

Because Spencer N-IV has no diatomaceous earth coating, fuel oil can penetrate it more evenly. This results in a better fuel balance and much higher blast efficiency.

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Please send me full details on Spencer N-IV as an ingredient in blasting.

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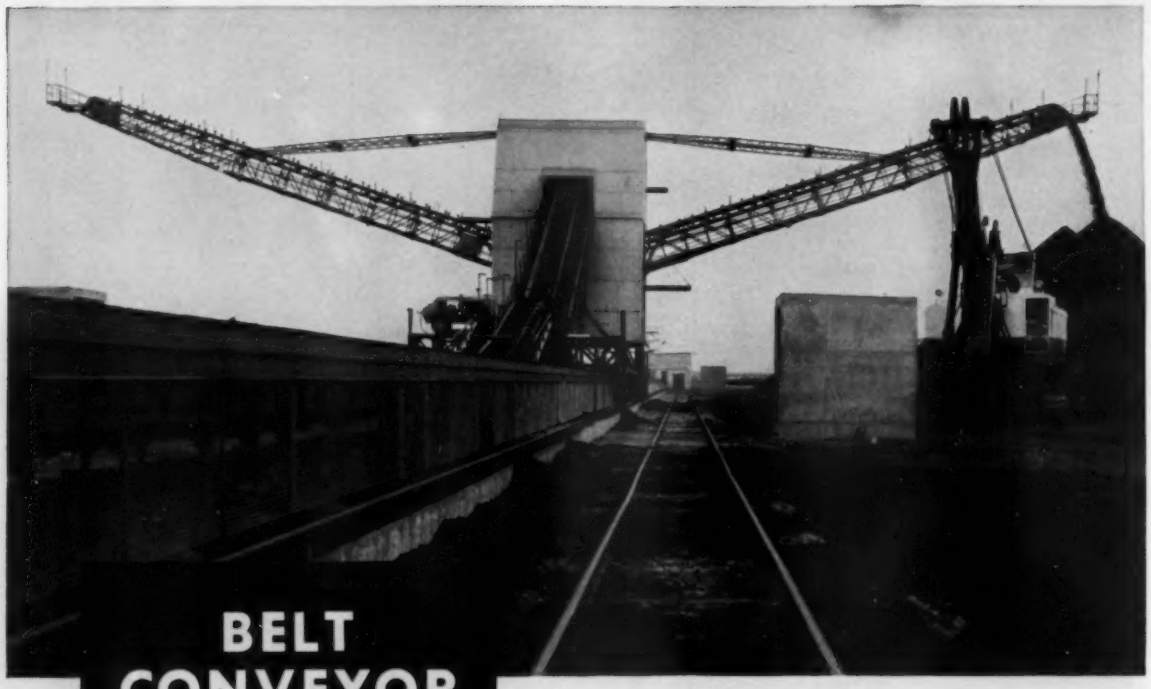

BELT CONVEYOR STACKERS

handle ore storage operations at lower cost per ton

S-A Belt Conveyor Stackers stock-pile large quantities of ore fast, efficiently and at lower cost per ton. Economy and dependability features are built into S-A Engineered Products for ore handling systems. STEPHENS-ADAMSON Belt Conveyor Stackers are handling greater ore tonnages daily, in many cases above and beyond the expectations of the design engineers, and with minimum "down time" maintenance. From mine to storage and from reclaiming to shipping, S-A Engineered Conveying Equipment is increasing tonnages handled and producing more profits per ton.

S-A ENGINEERED CONVEYOR PRODUCTS FOR ORE HANDLING SYSTEMS

S-A AMSCO FEEDERS
BULLETIN 255

S-A BELT CONVEYORS
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ENGINEERED BULK HANDLING SYSTEMS
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STEPHENS-ADAMSON MFG. CO.

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PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
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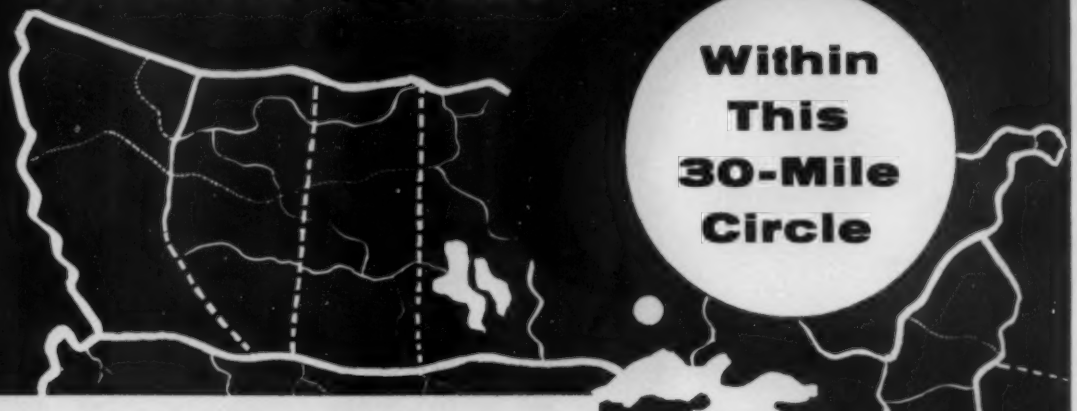
181 EIMCO FILTERS



Uranium Processors Choose Eimco Filters 4 to 1!

In Canada's Elliot Lake uranium producing area there are 181 Eimco drum and disc filters installed for acid leach and yellow cake processing. Why this preference for Eimco?

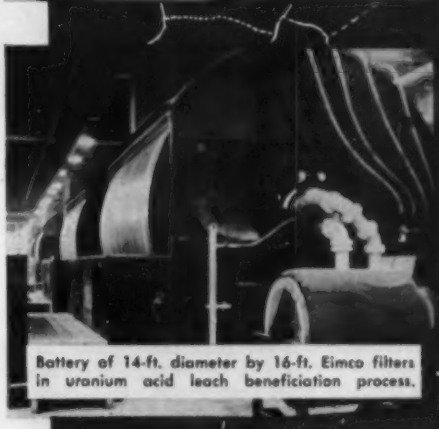
When mining men were trying new methods for uranium beneficiation, Eimco was able to offer, for their guidance, an unsurpassed backlog of past experience in building and applying filtration equipment for ore dressing.

Eimco's research and development staff undertook exhaustive studies of equipment adaptations that would be needed for profitable recovery. Recommendations were pre-tested in Eimco's modern laboratory and pilot plant before investments in equipment were made.

All Eimco equipment "proved out" right from the start. Eimco's streamlined Hy-Flow valve, for example, was first introduced on uranium filters to cut vacuum loss. In a test in the Elliot Lake area, pressure drop across these valves proved to be negligible.

The Eimco representative in your area can show you how Eimco engineering and equipment can keep tonnages up and costs down in your operations. Call him, and write Eimco Filter Division for new Filters Bulletin F - 2049.

Six-foot diameter Eimco drum filter is one of many producing yellow cake in Elliot Lake area.



Battery of 14-ft. diameter by 16-ft. Eimco filters in uranium acid leach beneficiation process.

SEE

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Proof from Jones & Laughlin!

Ni-Hard liners keep their contour after grinding better than 2 million tons of ore

Here's photographic proof from the Benson Mine, New York Ore Division of Jones & Laughlin Steel Corporation in upstate New York.

Ni-Hard liners keep their contour — resist abrasion — provide a slow, uniform wear rate — are good to the last ¼ inch.

You could never tell by looking at them, but these Ni-Hard* nickel-chromium-iron alloy shell liners have been grinding iron ore *for more than 2 years.* With better than 2 million tons of ore behind them, they've still got plenty of tonnage left in them!

Used in J&L's ball mills and rod mills —at the feed end as well as the discharge end—these Ni-Hard liners are delivering *superior abrasion and wear resistance.* They're saving many thousands of hours of downtime, many thousands of dollars in repair and replacement.

Try a set of Ni-Hard liners and see for yourself how the abrasion and wear resistance of Ni-Hard can increase *your* tonnage, can lower *your* costs.

Our detailed 58-page booklet, "Engineering Properties and Applications of Ni-Hard" suggests many ways to put this versatile and long-lasting material to work profitably. Say the word and we'll be glad to send you a copy.

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

NI-HARD®

NICKEL MAKES CASTINGS PERFORM BETTER LONGER

Aluminium Ltd. Reports Direct Reduction of Bauxite

The traditional middle step in converting bauxite to pure metal aluminum —the production of alumina—has been successfully circumvented by Aluminium Ltd. Work on a new process is far enough advanced to encourage construction of a $4 million plant, which, though experimental, will have annual capacity on the order of 8,000 tons. The new plant is being built at the company's Arvida works in northern Quebec and should be completed within two years. It is expected, however, that capacity output will not be reached for 5 to 6 years.

Cuba Seizes Moa Bay Mine

The U. S.-owned nickel and cobalt plant of Moa Bay Mining Co. in eastern Cuba was seized by the Castro government. The company, a subsidiary of Freeport Nickel Co., was confiscated along with more than $700 million worth of other U. S.-owned properties in Cuba. The plant had been closed since March when a heavy tax was levied on mineral exports.

Developing Michigan Copper Deposit

Copper Range Co. is expending $2 million to develop a newly-found copper deposit near the White Pine mine, owned by a subsidiary, in the upper peninsula of Michigan. Diamond drilling has outlined an orebody some 2000 ft beneath the surface and indicates that type of ore and mining conditions may be similar to those in the White Pine, the company said. A shaft is now being sunk and should be completed by the fall of 1961. If conditions are found similar to those at White Pine, Copper Range will establish a mining unit which would employ White Pine mill and smelter facilities.

New German and Russian Iron Ore Sources Pose Problems

Water bearing sands overlaying big new iron ore deposits in West Germany and the Kursk area of the USSR present production difficulties. Work is already underway on the estimated 300-million to 500-million ton German deposit near Nienburg, south of Bremen, where wet sand constitutes an 800-ft overburden. To reach the deposits, lying almost 4000 ft below surface, engineers are employing water freezing methods during shaft sinking to prevent flooding and subsidence. The Russian deposit, some 300 miles south of Moscow, is claimed to contain at least 30 billion tons of high-grade magnetite ore, said to be almost free of sulfur. Water problems vary from section to section of the big Kursk area but are seen as a delay factor in its development.

Huge Mapping Program in Canada

Geological Survey of Canada this year is assigning 87 groups, totaling some 385 men, to continue mapping the geology of Canada. Much of the effort will center on assisting the Roads to Resources program and northland development.

Some Aluminum Prices Boosted by Alcoa

Aluminum Co. of America, citing increased labor costs, announced price increases of ½¢ and ¾¢ per lb for certain grades and sizes of aluminum ingot and most aluminum mill products. Price of pig metal remains unchanged at 26¢ per lb.

MINING ENGINEERING REPORTER

Loan to Liberian Iron Ore Project

Export-Import Bank has allowed a $6 million credit to Liberia's National Iron Ore Co. Ltd. to aid in developing iron ore deposits in the Mano River district. The company, which is partially owned by the Liberian government, will purchase a total of $8.3 million of U. S. equipment, materials, and various engineering services.

Texas Uranium Mill

Susquehanna-Western Inc., Denver, Colo., has received an AEC contract for construction and operation of a 200-tpd uranium mill in Karnes County, Texas. The mill, which is to cost an estimated $2 million, will be the 26th privately owned and operated uranium-processing mill in the western U. S.

Miami Copper Dissolution Approved

Miami Copper Co. stockholders have approved the sale of the company's operating mines and plants in Arizona to the Tennessee Corp. and the subsequent liquidation of Miami. Tennessee Corp. will operate Miami's mines and plants in the Globe-Miami district and will acquire all assets of Chester Cable Co., Chester, N. Y.

CF&I to Explore Reservation Land

Colorado Fuel & Iron Corp., Pueblo, Colo., has purchased a prospecting permit covering some 120,200 acres of the Fort Apache Indian Reservation in Arizona. In an agreement with the White Mountain Apache tribe, CF&I offered a $42,100 bonus for two years of exclusive rights with the option to renew the permit for two years more on payment of another equal sum. Leasing would involve rental at the rate of $1 annually per acre, plus a 15¢ royalty per long ton of concentrate shipped from a plant and/or 20¢ per long ton of run-of-mine ore shipped directly.

Plan $1.5 Million Addition to Strategic Materials Plant

Strategic Materials Corp., in a follow-up to a pilot plant operation almost three years old, will spend $1.5 million for an expansion of its Niagara Falls, Ont. plant for potential production of stainless steels and heat-resisting alloys from low-grade lateric and chromite ores, using Strategic-Udy processes. Scheduled for completion near the end of the year, the plant will produce some 50 tpd of finished metal. The attempt to make the process commercial is being done in collaboration with Universal-Cyclops Steel Corp.

Tsumeb Schedules New Smelter and Refinery

Tsumeb Corp. Ltd. is adding plans for a lead smelter and refinery to its schedule of construction at its mines at Tsumeb, South West Africa. Scheduled capacity for the new plant, which is to be erected adjacent to the company's copper smelter, now under way, will have an annual capacity of 80,000 to 90,000 tons of refined lead. When the new lead plant is completed—some time in 1963—it will take mine output presently being shipped to the U. S. and Europe for processing. Arsenic, cadmium, and silver will also be recovered by the new facility.

Recover more of these minerals with Armour amine reagents ...for as little as 7¢ per ton of ore!

Spodumene
Ilmenite
Phosphate
Beryl
Cement Rock
Feldspar
Hematite
Kaolinite
Mica
Potash
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Vermiculite

Armour cationic flotation reagents produce the fastest attachments to minerals known—selectively float more concentrate in less time, at less cost!

Increased recoveries of minerals listed here—plus greater throughput—are economically achieved with Armour flotation reagents. That's because the coating reaction between an Armour flotation reagent and the *specific* mineral you want is *instantaneous!* Armour-treated minerals then attach to rising air bubbles quickly, firmly.

You use less equipment too, because the sharp selectivity of Armour cationic flotation reagents enable you to recover minerals without using an extra cleaner flotation step. You can float minerals from one ton of ore for as little as 7¢!

Armour—first to develop the use of cationic chemicals in flotation—continues to lead the way toward improved methods of applying these chemicals. Results of broad Armour research and experience are available in the 20-page booklet detailing the characteristics and advantages of cationic chemicals in flotation. Send coupon for informative booklet today!

Leading Specialists in Cationic Flotation Chemicals

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"Mineral Flotation with Armour Cationic Chemicals"..... ☐

Sample for floating_____

Information on these minerals (listed above)_____

Name_____

Firm_____

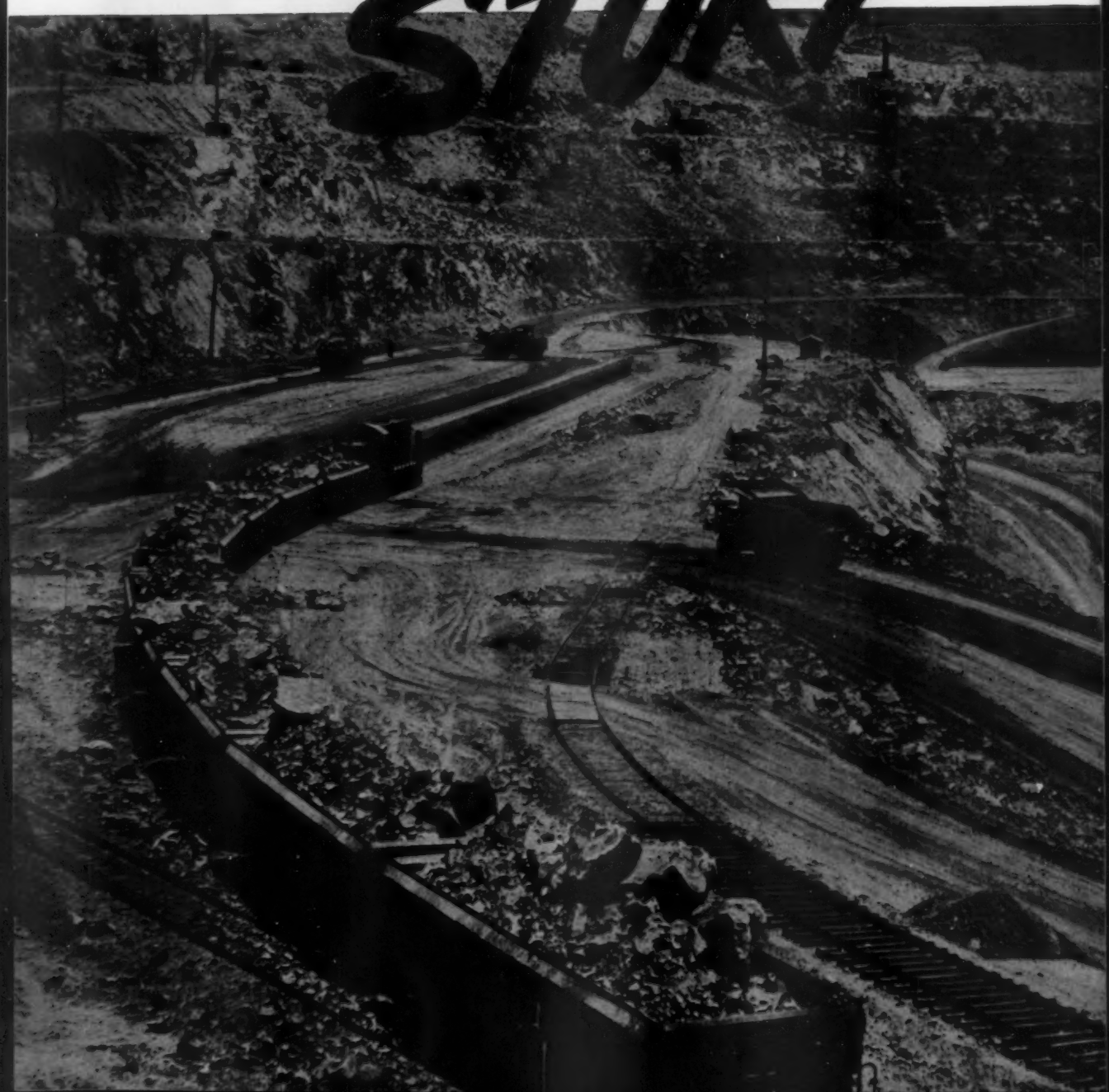
Address_____

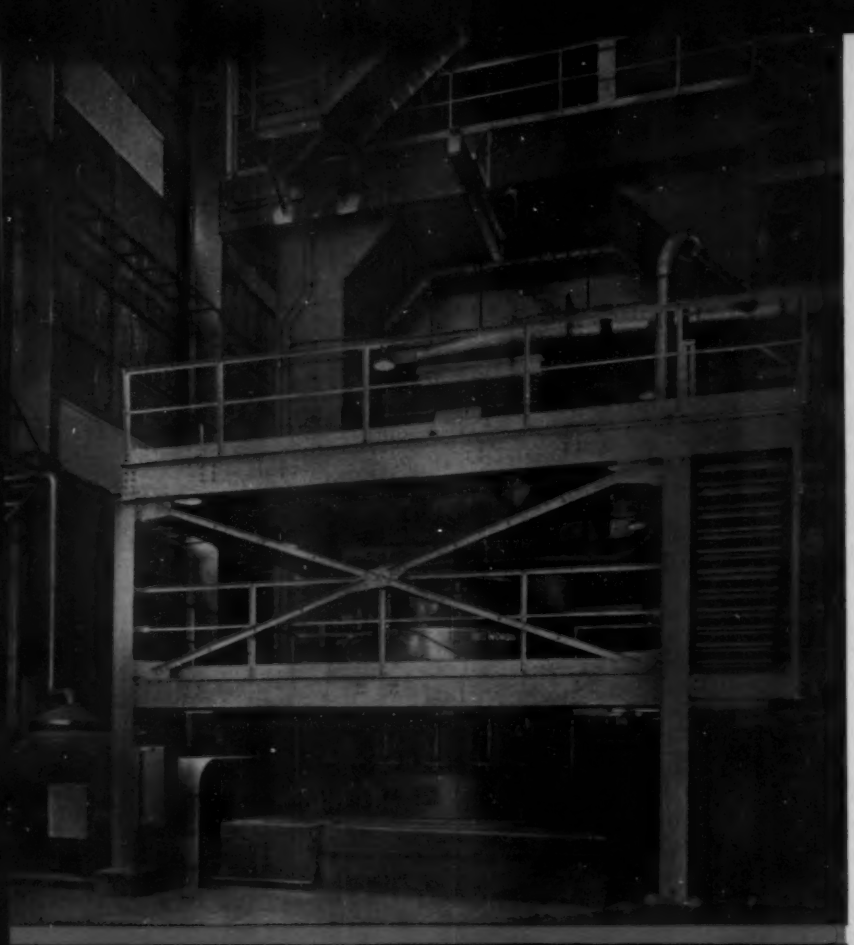
City_____ State_____

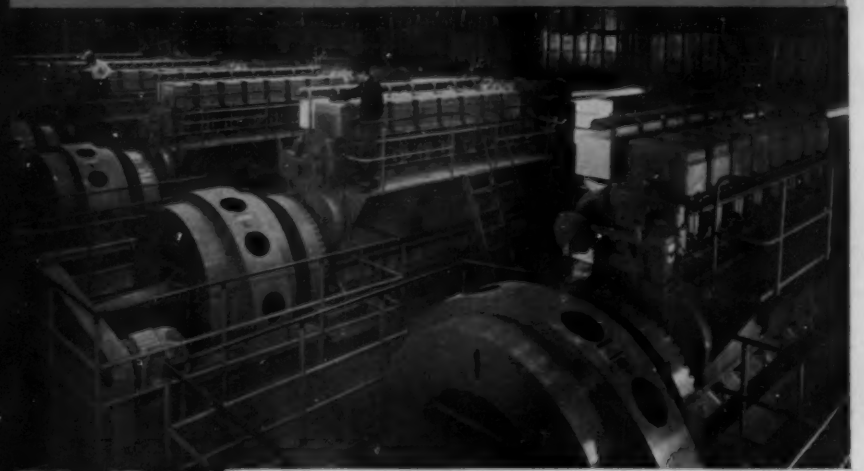
M6

Nordberg Machinery plays important part in the

"TOQUEPALA STORY"



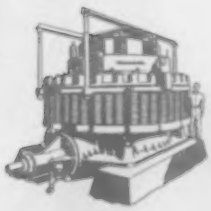




M-280 ©1960, N. M. CO.

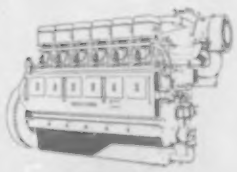
NORDBERG TRACK EQUIPMENT

An extensive railway system serves the Toquepala mine facilities. Nordberg equipment used by the contractor in laying rail included Power Jacks, Power Wrenches, Rail Drills, and a Hydraulic Spike Puller.



SYMONS® CONE CRUSHERS

Six Symons Cones handle secondary and tertiary crushing at the big Southern Peru Copper Corp. plant. Two of these are Standard units, and four are of the Short Head type.



NORDBERG ENGINES

Five Nordberg 4-cycle diesel engine-generator units are installed at the mine, 10,600 feet above sea level. Each of the 8-cylinder Nordberg supercharged engines is rated 1830 bhp, 1295 kw at their installed altitude.

■ The huge Southern Peru Copper Corp. open pit copper mine at Toquepala, Peru, is one of the major new mining projects of this decade. It is now in production, after more than five years of planning and development through the combined efforts of four large metal mining companies. Each of these companies have used Nordberg Machinery in their far-flung mining operations.

For, at Toquepala, as in most of the world's great ore and mineral operations, Nordberg Mining Machinery is playing an important part in the production of large tonnages of ore at low cost per ton.

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Milwaukee 1, Wisconsin

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MAUMEE COLLIERIES

At the Maumee Collieries in Indiana...

ANACONDA SHOVEL CABLE HAS A RECORD: 10 YEARS ON THE ROCK PILE!

Anaconda's SH-D Cable gives many years of dependable service in spite of heat, moisture, kinks, rocks and runovers!

How many shovel cable hazards can you count in this picture from the Maumee Collieries? Rocks . . . moisture . . . kinks . . . danger of runovers—they're all there. Yet the first installation of Anaconda's rugged SH-D Shovel Cable has resisted them all—*for 10 long years!*

It's proof again of the way Anaconda's in-the-field experience with Shovel Cable pays off in a superior cable for you. The important knowledge gained from use and testing of SH-D Cable *on the job* in our own mines goes into the design and manufacture of Anaconda Shovel Cable.

For example, the insulation is Anaconda Butyl (AB). Nothing can beat it for withstanding ozone, heat and moisture. Patented rubber cores cushion the ground wires and help prevent breaks from kinks and runovers. SH-D has a neoprene jacket that is exceptionally tough and abrasion-resistant. And every design, every component has been job-tested—your assurance of superior quality and performance.

Call on the Man from Anaconda with your cable problems. Or see your local Anaconda distributor. For new descriptive Bulletin DM-5818, "Anaconda Securityflex Portable Cables for the Mining Industry," write: Anaconda Wire & Cable Co., 25 Broadway, New York 4, New York.

For a decade, the Anaconda SH-D Shovel Cable you see here has been giving dependable service for the Maumee Collieries, Jasonville, Indiana. Its many superior design features enable it to resist on-the-job hazards that would knock out ordinary shovel cables.

ASK THE MAN FROM

ANACONDA®

FOR **SHOVEL CABLE**

REX® Conveyor components

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Rex Return and Flat Idlers

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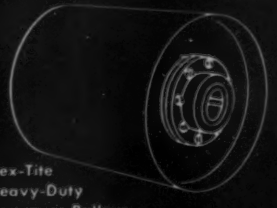
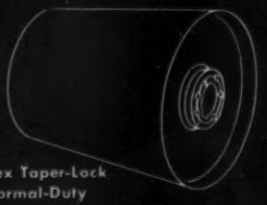
Rex Impact Troughing Idlers

Rex Spiral Return Idlers



Rex-Tite Heavy-Duty Conveyor Pulleys



Rex Taper-Lock Normal-Duty Conveyor Pulleys

to the salt mines...FOR LIFE

There's just one reason why Rex-Rated Idlers were sent to the salt mine shown above...International Salt Company knew in advance that these idlers would provide maximum service life under punishing corrosive conditions and continuous heavy loads. Years of service have proved the decision was right. Down time has been kept to a minimum.

The main reason why Rex-Rated Idlers eliminate guesswork and costly selection errors is because the Rex-Rated line is complete with idlers for every application. And every Rex Idler is accurately rated to provide exactly the operating life required under specific operating conditions. A simple selection chart tells you in advance exactly which idler you need and what kind of service to expect before you buy.

The Rex Rating System and the Rex line are the results of years of experience in idler design and testing by Rex Engineers.

Why risk costly errors? Specify Rex-Rated Idlers. Write CHAIN Belt Company, 4794 W. Greenfield Ave., Milwaukee 1, Wis. In Canada: CHAIN Belt (Canada) Ltd., 1181 Sheppard Ave. East, Toronto.

REX®

CONVEYOR SYSTEMS AND COMPONENTS

A. *RCV 10x20 unit providing vacuum for ore purification.*
B. *RCV 8x16 units in a carburetor testing operation.*
C. *RCV 12x18 units in Combustion Tests Section, U.S. Bureau of Standards.*
D. *RCV-2 and RCV units supplying vacuum for newsprint making machine.*
E. *RCV 10x18 and 10x15 units serving cigarette-making machines.*

In a variety of applications Roots Vacuum Pumps deliver

MORE CFM PER DOLLAR

The high operating speeds of Roots-Connersville blowers for vacuum service result in lower horsepower requirements. Power savings of as much as 25% are possible. What is more, the simple, rugged rotary positive design of these vacuum pumps provides additional savings in initial cost, long-term investment, maintenance and floor space. These advantages are being demonstrated in a wide variety of mining, paper making, chemical processing, general manufacturing and testing operations.

Type RVS vacuum blowers are offered for efficient low volume service. Designed to handle capacities ranging from 30 cfm to 1,000 cfm, they can operate up to 20" Hg. vacuum in single stage construction.

Type RCV units are available for air and gas handling capacities from 500 to 13,000 cfm and are recommended for vacuums up to 17" Hg.

Type RCV-2 compound units consist of two RCV's on a single driving shaft and are recommended for highest efficiency from 18" to 27" Hg. vacuum when handling capacities from 1,500 to 15,000 cfm.

Your nearest Roots-Connersville sales engineer can give you full details. Or write for Bulletin VP-158 (RCV) and S-RVS-159 (RVS).

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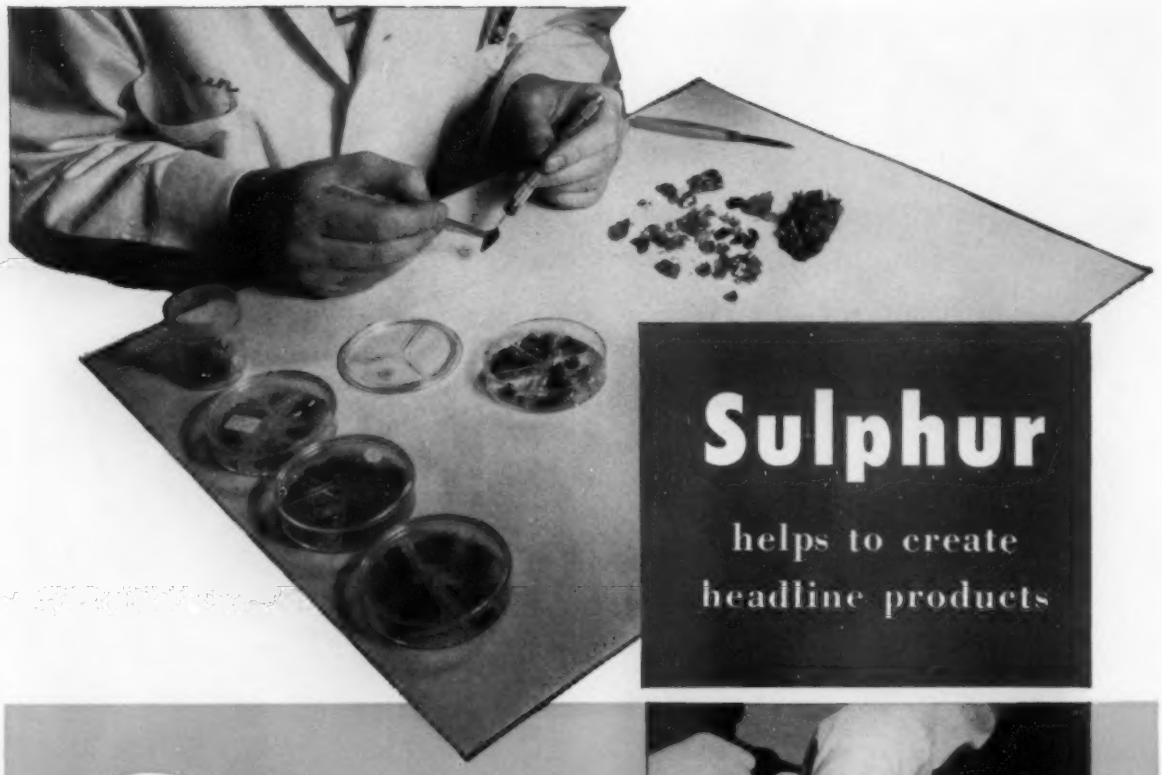
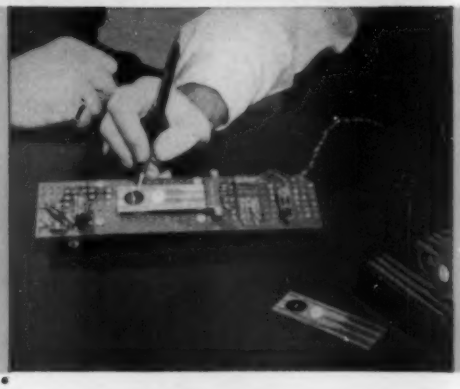


Sulphur

helps to create headline products

CdS • • • a new concept in field-effect transistor design



General Motors Research Laboratories has recently announced the application of a new transistor material ... the cadmium sulphide crystal which offers several distinctive values over the single type atomic material. Its outstanding characteristic is that it is controllably sensitive to and affected by light and other radiations.

CdS provides another interesting development where Sulphur is importantly in the picture ... a development that may have far-reaching effects in the broad field of electronics.

Sulphur and its many derivatives, either directly or indirectly, have a part in the creation of countless products, adding to the strength of our economy. Our business is to produce Sulphur—molten as well as solid—and have it available in sufficient tonnages at several departure points to serve any plant in the United States or Canada. Supplementing this basic policy, we are developing centralized distribution centers for quicker service.

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CYANAMID

Reagent News

"ore-dressing ideas you can use"

Ever-Widening Use of Cyanamid 800 Series Promoters

- **for Floating Fe_2O_3 from Non-Metallics**
- **for Concentrating Low-Grade Iron Ores**

HERE'S THE BOX SCORE ON CURRENT USE OF CYANAMID 800 SERIES PROMOTERS:

Feed	No. of Plants	Feed	No. of Plants
Glass Sand—Feldspar	18	Garnet	1
Iron Ore	3	Columbium	1
Chromite	3	Kyanite	1
Barite	2	Manganese	1

At glass sand, feldspar operations, iron-bearing minerals are floated away after the feed has been conditioned with approximately 0.3 lb./ton AERO® Promoter 824 or 825 and 0.7 to 1.0 lb/ton AERO® Promoter 801 with up to 0.5 lb/ton fuel oil. Sulfuric acid is used to lower the pH to 2.5-3.5 during conditioning. Pulp density is kept high and AEROFLOAT® 31 Promoter is added as an auxiliary frother.

This 800 Series promoter combination will preferentially float both magnetic and non-magnetic iron-bearing minerals but may not remove iron occurring as mineralogical inclusions in the silica grains. Surface stain can usually be removed by a preliminary attrition scrub and desliming, with or without an acid leach.

Glass sand products as low as 0.02% Fe_2O_3 are produced regularly at many operations. In cases of silica occuring with feldspar, after removal of the iron-bearing minerals by flotation with 800 Series Promoters, both silica and feldspar products can be produced by the standard feldspar flotation method. This involves conditioning of the low-iron pulp with HF and flotation of the silica from the spar with a cationic collector such as AEROMINE® 3037 Promoter and an AEROFROTH® Frother, as required.

For low-grade iron ore concentration, a typical flow scheme of a large U.S. iron-ore beneficiation plant combines gravity separation with froth flotation. At this plant, gravity concentrates are produced by spirals. Spiral tailings are ground and deslimed in cyclones to produce a flotation feed running 30 to 35% Fe. Conditioning is done at 65% solids with 3.0 lb/ton H_2SO_4 to maintain a pH of 5.0; approximately 1.9 lb/ton AERO® Promoter 899; 0.7 lb/ton fuel oil and 0.4 lb/ton tall oil.

Flotation concentrates are cleaned and recleaned with the addition of up to 1.4 lb/ton sodium silicate. Final concentrates from flotation feed running 30 to 35% Fe now average 58 to 60% Fe with 6 to 8% SiO_2. Iron recovery runs 65 to 70%.

• • •

The 800 Series Promoters have also shown good results on a laboratory scale for treating bauxite, fluorspar, tin, oxide copper, dolomite, phosphate, tungsten, celestite and lithium ores.

For further information on flotation with the Cyanamid 800 Series Promoters, get in touch with the Cyanamid office nearest you.

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EXPLOSIVES AND MINING CHEMICALS DEPARTMENT

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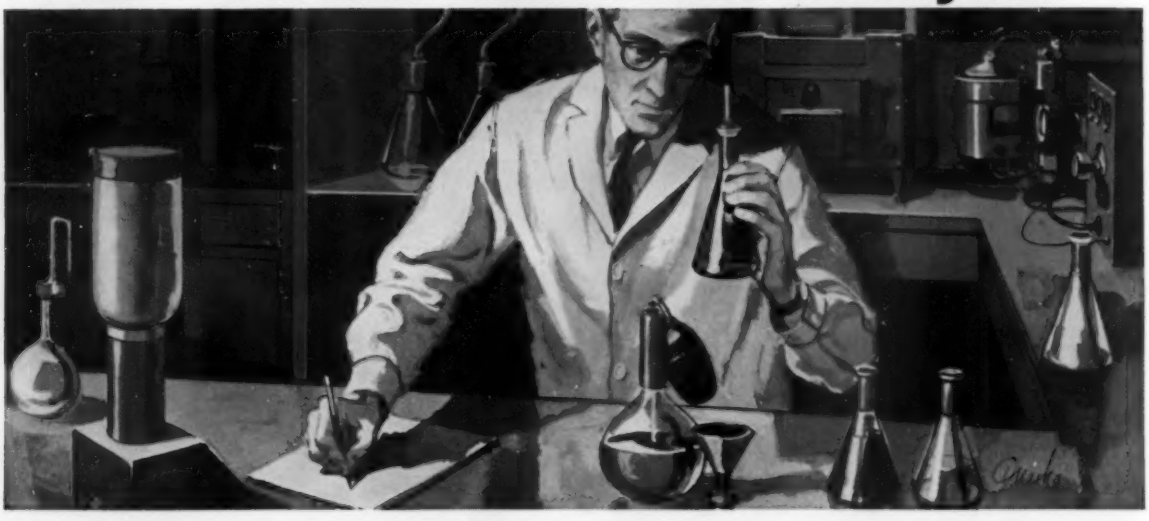

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onto the line!

General Electric's revolutionary X-Ray Emission Gage offers what amounts to an "on-line" *laboratory* for quality control. XEG performs continuous analysis of solids, liquids, liquid mixtures, slurries, powders, sheets, rods, wire or similar materials *during actual production.* It monitors up to 5 selected elements . . . maintains *moment-by-moment* surveillance, sensing both presence and quantity.

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Visit CF&I

When you're at the American Mining Congress, October 10-13, in Las Vegas, drop in at CF&I's booth 1004. The exhibit will feature the complete line of quality steel products CF&I manufactures for the Mining Industry.

Engineers will be on hand to answer any questions you may have, or you are welcome to use our message center, make phone calls, use our secretarial service, or just relax in a pleasing atmosphere. 7853

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Your final decision to expand or build results from a series of important individual decisions. Raw material availability is one of them. Independent analysis of all aspects of your proposed program is the *Pre-Engineering* service offered by Kaiser Engineers. In addition, KE is an experienced designer and builder of all types of facilities for the Minerals industry. From Pre-Engineering through design and construction Kaiser Engineers provides complete one-company service and ingenuity based on years of experience.

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DE RE DIRECTORIA

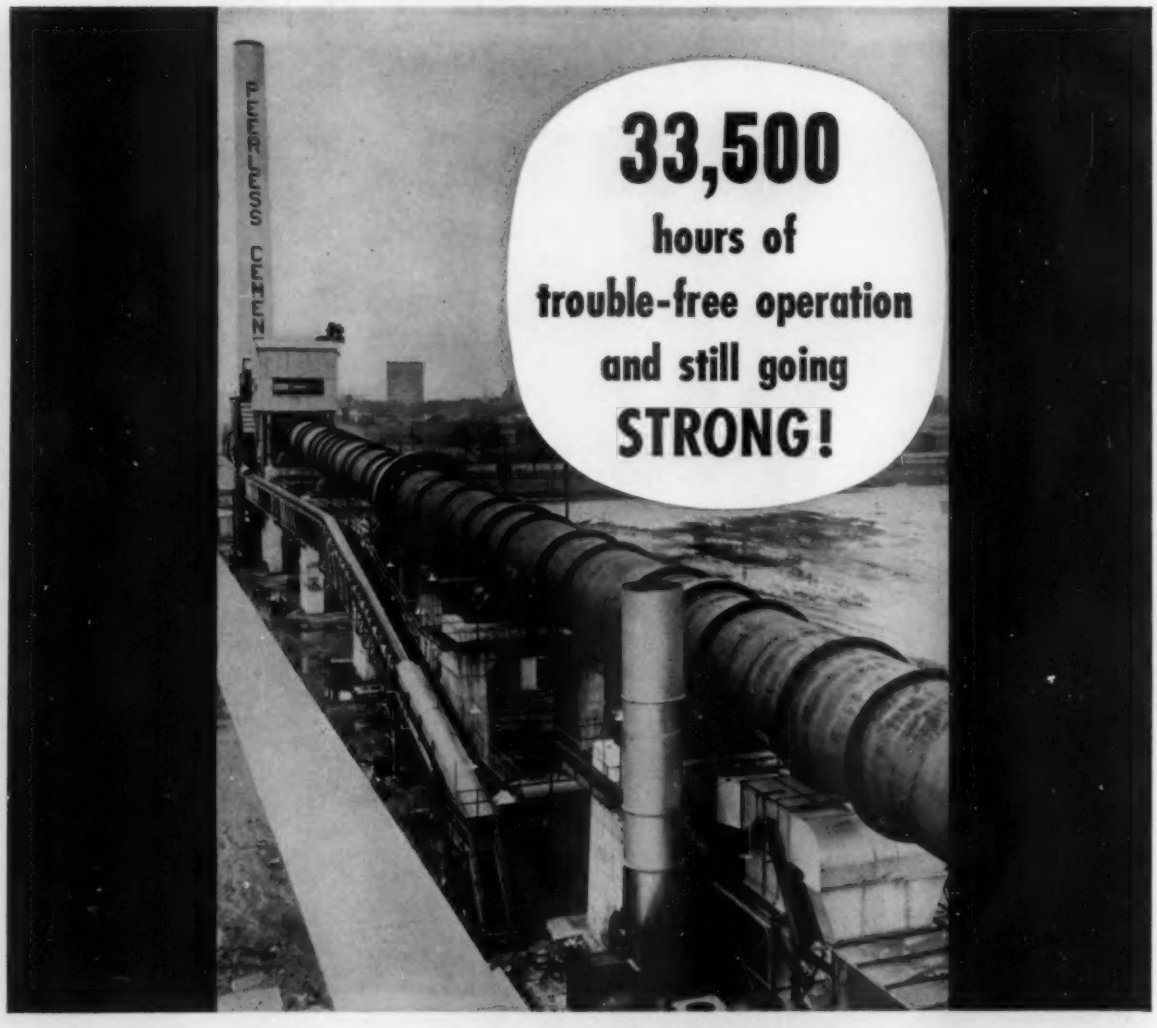
It has been brought to our attention that there are a number of errors in the 1960 SME Directory. The number is not great. Percentagewise it is negligible. In any compilation of 130,000 items arranged ten at a time, the opportunity for error is enormous. The ten items are: name, title, company name, street number, city, state, grade of membership, year of election, divisional affiliation and availability for consulting. And there are about 13,000 members. When this information is used twice—for the alphabetical directory and the geographical directory—the opportunity for error becomes astronomical.

We realize that each listing is vitally important to the man concerned and do our utmost to avoid mistakes. Unfortunately, due to the innate perversity of inanimate objects, some errors sneak past even the most expert proof-reader. However, in the majority of cases called to our attention we have found that the member has neglected to complete and return the questionnaire sent him. As a result, last year's errors are projected into this year's directory and the opportunity for error is compounded.

To avoid perpetuating errors and compounding them, each directory is started from scratch. Each year a new directory questionnaire is sent to each member. Complete cooperation would mean a directory almost 100 percent correct on the day issued. But cooperation falls far short of completeness; hence there are more errors than we—and you—like to see. It takes only a few minutes to fill in the five lines or so asked for; to check date of election, grade of membership and divisional affiliation.

AIME records may be correct, last year's directory listing may have been correct. But only by making sure that the current directory questionnaire is returned *completed* and *correct*, can you be reasonably sure that everything the current directory says about you is true.

You will receive a new directory questionnaire next March. Make a note now to help us make the 1961 SME Directory 100% correct. *J. C. Fox*



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TKA-10

CONTROLLING FIRES IN MINES WITH HIGH-EXPANSION FOAM

JOHN NAGY, EDWIN M. MURPHY, AND DONALD W. MITCHELL

In 1957 research was initiated in the U.S. Bureau of Mines experimental coal mine near Pittsburgh, Pa., to study factors affecting foam generation and transport, to evaluate the effectiveness of high-expansion foam for controlling mine fires, and to develop techniques for applying the method under U.S. mining conditions. These investigations showed that high-expansion foam containing at least 0.2 oz of water per cu ft of foam is effective in controlling experimental underground fires burning coal, wood, and oil. Sometimes the fire was completely extinguished, but more often, it was brought under sufficient control to permit either a direct attack on the fire with a stream of water or loading of the hot material into cars.

A progress report[1] prepared in July 1958 summarized the initial achievements of the USBM experiments. Since then other phases of the foam-plug method for attacking fires have been studied in the laboratory and in the mine. Previous studies by British engineers[2] of the foam-plug method for fighting mine fires indicated that high-expansion foam was effective in controlling experimental timber fires in an underground passageway. Their subsequent work[3, 4] pertained to the practical aspects of fighting large fires within a mining area with a foam-plug.

CONTROLLING EXPERIMENTAL FIRES

In the USBM tests foam was formed by spraying a dilute solution of a foaming agent on a metal or cotton net of ⅛ to ¼-in. mesh. Air passing through the continuously wetted net forms bubbles of ½ to 1½-in. diam and produces a honeycomb of foam that fills the passageway. Under the ventilating-air pressure, this light-weight plug moves forward through the passageways, around sharp corners, and over obstacles, as illustrated in Fig. 1.

High-expansion foam was transported to a wood fire, an oil fire, and 13 coal fires. Figs. 3 and 4 show a typical coal fire before and after attack with foam. In 12 of the 15 experiments the fire was brought under control when the water content of foam was 0.2 oz or more per cu ft. A fire was considered *controlled* when the flames were quenched and observers could cross the area without wearing breathing apparatus or protective clothing. In the other three experiments, conducted when the water content was less than 0.2 oz per cu ft of foam, the flames were retarded but the fire was not controlled.

Coal fires have been attacked successfully by foam introduced at points varying from 155 to 1010 ft from the fire. The time of burning in coal beds 10 in. thick ranged from 1½ to 5 hrs or more. Most of the experimental fire beds were 15 ft in length. However, in one experiment a floor fire 25 ft long and 5 ft wide was constructed 75 upwind from another fire 15 ft in length; in another instance, the fire was 100 ft long and 5 ft wide. Foam was applied to the fires for periods ranging from 7 to 36 min. The time required for foam application depends on the extent of the fire, time of burning, water content of foam, foam velocity, and degree of fire control desired.

In addition to the coal fires, foam was transported to a fire covering 45 sq ft, produced by 15 gal of oil burning in metal trays on the floor. The foam extinguished the oil fire in about 1 min. In one other test, the burning of 1100 lb of dry sawmill slabs stacked in open cribs 4 ft high and 16 ft long was brought under control by foam in 2 min.

Composition of Gases in Return Air: In several of the experiments samples of the return air from fire zones were collected; composition of the atmosphere before, during, and after foam application was then determined. Because of condensation in the relatively cool sampling tube, the amount of water vapor was not determined. Analyses showed that concentration of carbon dioxide and combustible gases increased as the foam began passing over the fire. This resulted from the decrease in the volume of air when foam generation started and from the formation of gases when water reached the fire.* The quantity of gases generated would not be greater than that from an equivalent amount of water applied directly to the fire.

The highest total concentration of combustibles (CO, CH_4, and H_2 mixture) obtained during the experiment was about 2 pct; this occurred 6 min after foam reached the fire. This atmosphere was nonexplosive, but calculations show that if the air flow were reduced to about 5 fpm and if the rate of gas liberation from the fire remained constant, the mixture would be explosive. The use of foam on a fire in all probability would affect the normal ventilation of a mine. If the mine is gassy, this factor must be carefully considered before the foam is applied.

APPLICATION OF THE FOAM-PLUG TECHNIQUE IN MINES

Equipment and procedures for applying the foam-plug methods must be adapted to the prevailing conditions at a particular mine. Some factors to be considered in developing equipment are: size or extent of the mine, dimensions and number of entries, ventilation system, mining methods, haulage facilities, availability of water, amount of methane liberated, and existing fire-control apparatus.

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* In most experiments the initial air velocity of 200 fpm decreased to 50 to 100 fpm as the foam plug increased in length.

In many coal or metal mines the ventilating air pressure may be insufficient to transport foam a reasonable distance. To overcome this difficulty the USBM built a portable foam-generating device (Fig. 2). The 5-hp fan used in this unit develops a maximum pressure of 3 in. water gage and has sufficient capacity to drive foam for 1000 ft at about 100 fpm in the 65-sq ft entries of the USBM experimental coal mine.

In using the high expansion foam method on a fire, consideration must be given to ventilating the affected area, particularly if there is much methane present. The foam plug alters the normal ventilation pattern and the action of the fan incorporated in the portable generator may reverse or block air in some workings. Foam can be used on a gob fire if the ventilating air can be directed through the fire area. It should not be used in haulageways or other entries where energized trolley or other electric-service wiring is exposed.

When high-expansion foam is applied to a fire in an operating mine, foam generation and the foam's advance and action cannot be observed as they can in experimental research. However, foam generation can be noted if a light is placed about five ft beyond the net and near the roof of the mine entry. This light is obscured if foam is being generated satisfactorily. In addition, movement of the foam plug can be determined by observing the air pressure driving the plug. With the USBM's portable unit, a pressure gage (water *U*-tube) in the casing just beyond the fan indicates the driving pressure; this pressure increases gradually as the length of the plug grows, and it becomes constant when the plug reaches the fire. Measurement of the quantity of air moving through the net or into the fan indicates the foam plug's rate of advance. If the extent of the fire is known before foam is applied, the duration of the foam attack can be based on information gained in the experimental studies. If the extent is not known, foam should be applied for about 30-60 min. If possible, the equipment should then be moved closer to the affected area. A water spray can clear the entry of foam for this purpose.

LABORATORY STUDIES

Laboratory studies show that several commercial foaming agents may be used. However, ammonium lauryl sulfate possesses many desirable qualities and produces a relatively stable foam having adequate water content. The amount of solution required to create foam increases with the hardness of the water, but it is not affected by acidity or alkalinity of the water. With soft water, the lowest concentration of the active ingredient in the foaming agent is about 0.4 pct. Use of mine water should be avoided, but the hardness can be neutralized by treatment if necessary. Below 40°F the amount of water retained in the foam increases appreciably and excessive air pressure is required to move the plug. Under this circumstance, foam can be lightened by adding 15 to 20 pct alkyl aryl sulfonate to the

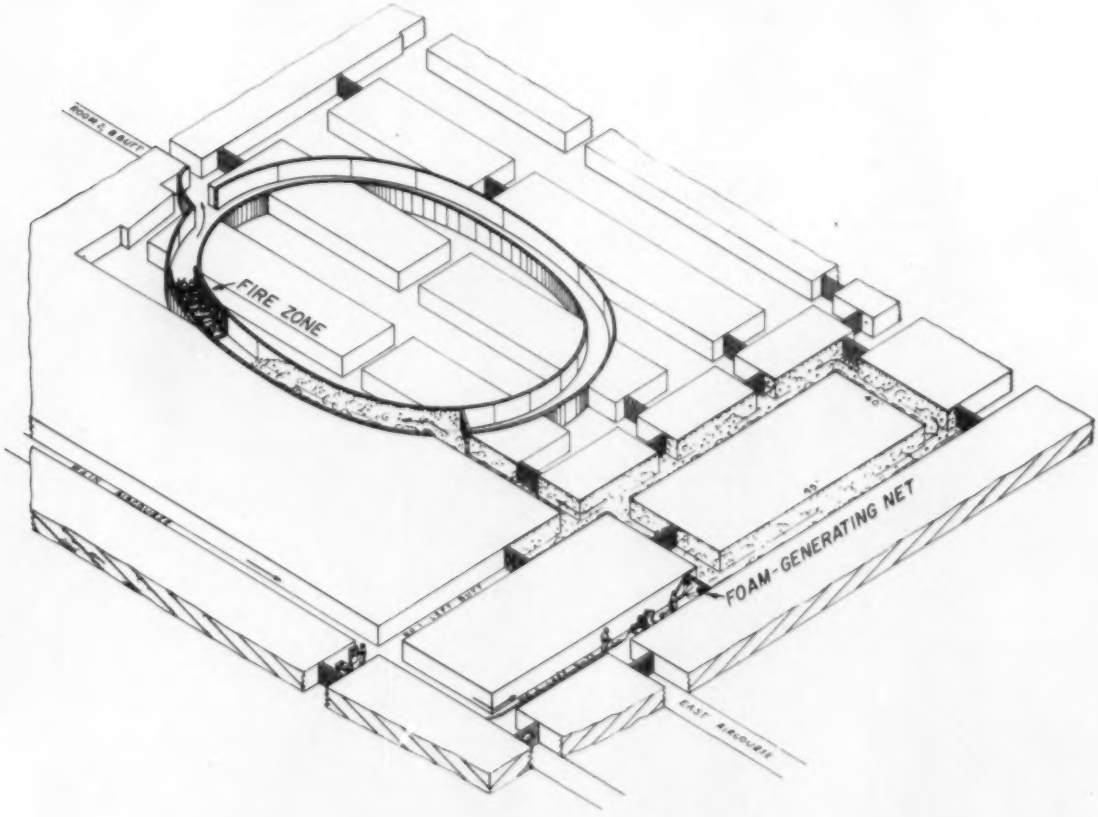
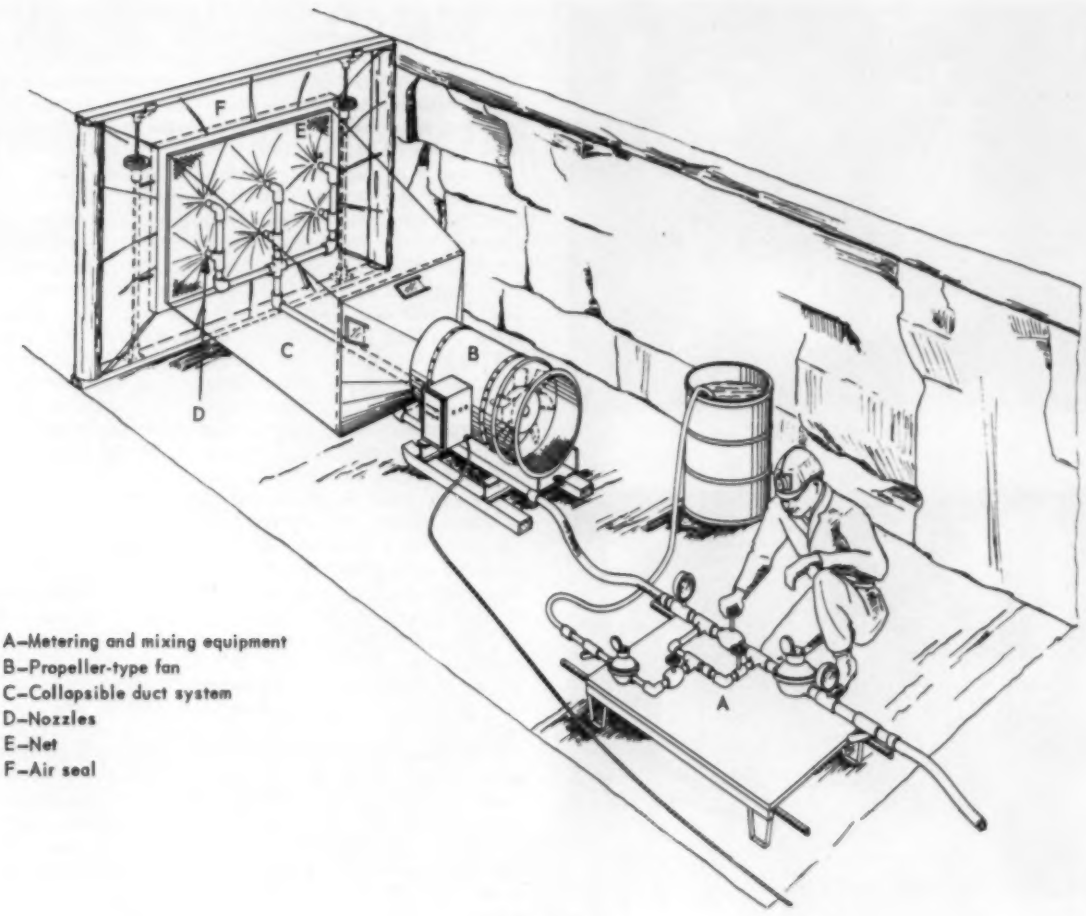


Fig. 1



A–Metering and mixing equipment
B–Propeller-type fan
C–Collapsible duct system
D–Nozzles
E–Net
F–Air seal

Fig. 2

foaming agent. When the water temperature is above 70°F, viscosity intensifiers can be added to decrease the rate of liquid drainage.

Ammonium lauryl sulfate from a single supplier was used in most of the USBM tests. When different brands were tried their water-retention capabilities were found to vary slightly, but the difference was easily corrected by maintaining a lauryl alcohol content of 2 to 3 pct.

Several methods can be used to evaluate foaming agents. Perhaps the simplest is an homogenizer test[5] in which 100 cu cm of solution are agitated for 30 sec in a glass vessel. The height of the foam produced and the quantity of water drained are then measured. In this test the foam from an effective agent will retain 30 to 40 pct of its water after draining 15 min.

FOAM GENERATION AND TRANSPORT EXPERIMENTS

As received from the manufacturers, ammonium lauryl sulfate contains about 30 pct active ingredients and it has the consistency of a heavy liquid (its viscosity exceeds 20,000 centipoise). When diluted with an equal amount of water, the foaming agent becomes a free-flowing liquid with a viscosity of about 60 centipoise.

Several methods can be used to introduce the foaming agent into the water stream. The highly viscous commercial product can be injected and metered directly into the main waterline by a pneumatic or electric pump. A relatively inexpensive eductor can be connected as a bypass around the main water-control valve, or an in-line proportioner can be installed in the main water line to draw the diluted solution. Another relatively simple method uses air pressure to force the diluted detergent from a tank into the water line, or a water pump can be used in the discharge line from a tank. With all methods, proper metering or control of concentration is necessary.

It should be remembered that although a foam-generating unit developed around a tank containing mixed solutions has many desirable features, the quantity limitations imposed by such a tank would

Table I. Ventilating Pressure Required to Transport a Foam Plug in the Mine Entry

Length of Foam Plug, Ft	Water Content of Plug Front, Oz per Cu Ft	Water Pressure, In.
200	0.9 to 1.3	0.4 to 0.6
500	0.5 to 0.9	0.8 to 1.0
1,000	0.5 to 0.9	2.0 to 2.2
1,500	1.0 to 1.4	4.8 to 5.0

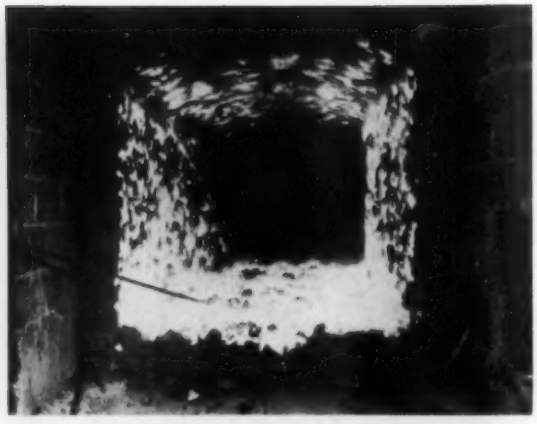


Fig. 3

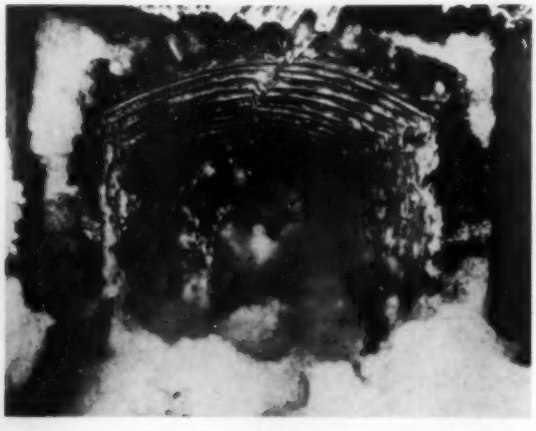


Fig. 4

be restrictive. On the other hand, equipment adapted to a pipeline water supply would eliminate this restriction, and haulage from a surface or underground depot would be limited to moving a few barrels of foam agent.

To generate foam satisfactorily, the net must be kept wet with foaming solution. Uniform spray application is desirable but not necessary if an excess of solution is used. Several commercial full-cone fog nozzles were used successfully in the USBM tests. The solution loss at the net ranged from 15 to 25 pct of the total quantity applied, but much of this could be trapped and recirculated if desired. Foam can be generated satisfactorily with a net of the same area or with an area less than that of the entry, provided the air velocity through the net ranges from 80 to about 600 fpm. With the net of smaller area properly sealed in the passageway, the foam flows as it is generated and fills the entire entry. A small net is installed more quickly and easily than a large one.

Length of the foam plug depends primarily on available air pressure; the roughness and other characteristics of the road surface; and the water content, viscosity, and other properties of the foam. Loss of solution at the net decreased, and the initial water content of the foam increased, with an increase in initial air velocity. Maximum plug length was proportional to the logarithm of available air pressure. At a given air pressure the length of the foam plug decreased as the water content of the foam increased. Average values for the length, the water content of plugs, and the corresponding air pressures required to drive the foam generated with 0.4 pct solution are given in the accompanying table (page 995).

In one test foam was generated initially with the mine fan, and after a 900-ft foam plug had developed, the small fan of the USBM's portable unit was started. In this way the foam advanced a total distance of 1600 ft from the net. Actually more than 2000 linear ft of foam was ultimately generated in this 72-min test inasmuch as the foam also filled some abutting passageways. Measurements at a station 1300 ft from the net showed that the plug front contained 1.4 oz of water per cu ft of foam 48 min after the start of the generation of the foam. The maximum driving pressure applied to the plug was 5.2 in. of water pressure. In a second trial foam was generated with the portable unit only; the plug had advanced 1020 ft when the fan stalled at 2.9-in. water pressure. In a third trial the mine fan was operated at a medium speed in opposition to the portable unit (the mine fan has a pressure potential equivalent to 1 in. of water at this speed). When the small fan was started, it reversed the air movement in the entry and foam was moved 760 ft away from the net. The effective driving air pressure was 1.9 in. of water, or the difference between the pressure potential of the small fan and that of the main mine fan.

Additional experiments in the mine showed that foam plugs could be generated equally well in either a blowing or an exhausting ventilating current, as well as in an atmosphere of reduced oxygen (black damp). Furthermore, foam travel was not affected by an obstruction which restricted the area of an entry by as much as 90 pct; in tests, the foam expanded from an entry 7 ft high to fill a cavity 17 ft high. In another experiment, foam was driven up a 50-ft vertical shaft with a pressure equivalent to 1-in. water gage.

SUMMARY

The experiments conducted by the USBM have shown the potential value of the foam-plug method for fighting fires in either coal or metal mines. An incipient fire should be attacked promptly with water, rock dust, or other approved and readily available extinguishing agents; where heat, roof falls, and smoke prevent a direct approach to the fire, the somewhat more involved procedure of using foam may be effective. The official report pertaining to the results of these experiments and the suggested procedures for applying such methods were recently published by the Bureau.[6]

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THE BOWERS-CAMPBELL MINE

TRI-STATE'S BOOT-SHAPED ZINC DEPOSIT

by LARRY G. HAYES

Tri-State Zinc Co.'s orebody in Virginia features an unusual spiral-shaped access-haulage adit admirably suited to this deposit. Ore is mined by open-stoping utilizing the basic room-and-pillar method.

Development of the Bowers-Campbell zinc deposit, located in the Shenandoah Valley two miles northwest of Timberville, Va., was commenced in 1956 by the Tri-State Zinc Co. The occurrence of lead-zinc mineralization in this area has been known for many years, but the first serious exploration program was initiated in 1951 by the geologic staff of Tri-State Zinc Co.

GEOLOGY

The orebody is a mineralized breccia lens enclosed in the Beekmantown formation of the Upper Ordovician dolomites. The deposit is approximately 700 ft long, 100 ft wide, and 475 ft thick. Its projected plan has an elongated ovoid shape, whereas the profile appears boot-shaped with the upper portion outcropping. Vertical cross sections show the lense as having been thrust-faulted along certain bedding planes. The movement along these bedding thrusts varies greatly and in one case, has offset the deposit so as to divide it into an upper and lower orebody. The breccia lense strikes parallel to the N 34° E strike of enclosing strata.

The only economic mineral found in the breccia is sphalerite, which occurs as crystals alone and in stringers within the white breccia cement. Con-

L. G. HAYES, Member of AIME, is Superintendent of the Bowers-Campbell Mine, Timberville, Va.

Fig. 1—Aerial view of the Bowers-Campbell mine.

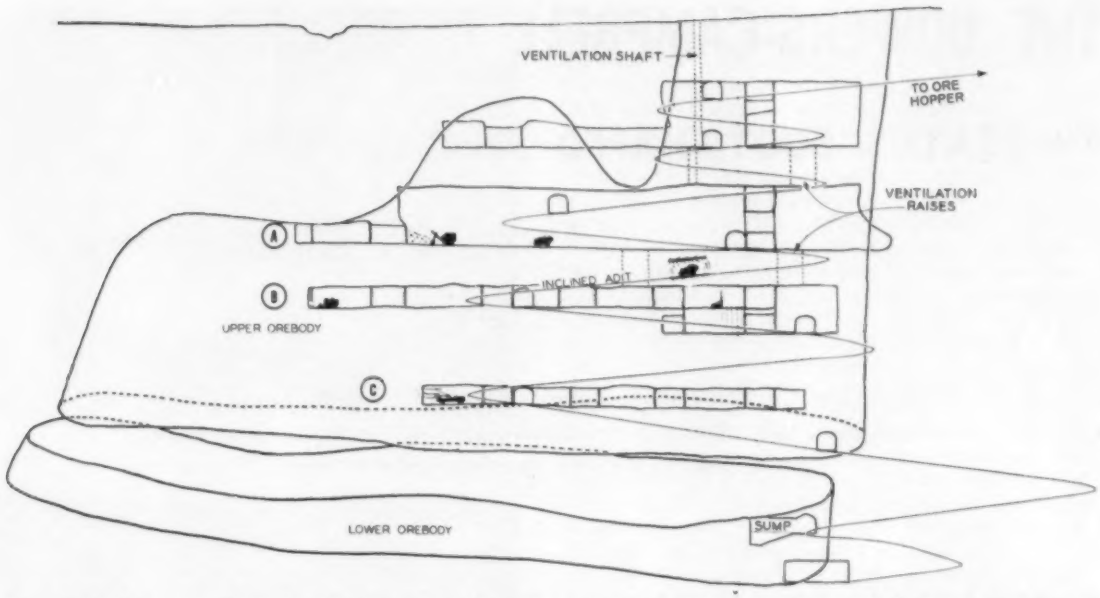

Fig. 2—Profile section through orebody. A to C show three stages in mining: A, level in final stages of mining; B, mining of upper and lower slices in one level; C, initial breast stoping and removal of upper slice on new level.

siderable pyrite occurs in conjunction with the sphalerite. Some small galena crystals have been found, but only in or near the wall contacts of the breccia. Greenockite, like the galena, is found in the wall contacts, and having a distinctive color, it serves as a good indicator when mining approaches the ore limits.

THE MINING OPERATIONS

Both the ore and surrounding country rock are strong enough to stand over a comparatively long span without artificial support. Consequently the size, shape, and attitude of the lense makes a modified form of room-and-pillar mining feasible. With this in mind, and in view of the good results obtained from other operations by trucking ore direct from stope to surface mill over inclined adits, a mining plan was devised which provided an inclined adit for access and haulage (Fig. 2).

Driving of Adit: The inclined adit, 17x14 ft in section, was driven in a series of "straight-aways" and "loops" in the footwall of the orebody. The adit has a −10 pct grade for the first 3400 ft and a −13 pct grade for the remaining 950 ft. After the initial 550 ft to the first access crosscut of the orebody, the adit makes seven complete loops, ending at the base of the lower orebody, approximately 4350 ft from the starting point. Looping was necessary to make the adit fit the mining plan of the comparatively short orebody and to facilitate dewatering and ventilating the adit while it was being driven. Upon reaching a point in the adit above which the bulk of the ore would be transported over the −10 pct grade, the slope of the adit was steepened in order to shorten the tunnel. With one exception, the minimum radius of the curves is 45 ft. The many curves have made it necessary to regulate traffic in the tunnel by a stop-and-go signal system.

The face of the adit was dewatered with air-operated sump pumps and electric booster pumps discharging into a 16-in. churn drill hole equipped with a 6-in. turbine pump. The churn drill hole was tapped with 3½-in. holes from each loop of the adit.

The adit was ventilated through 18-in. tubes which passed through raises driven between the various loops. Booster blowers forced fresh air from the surface through these ventilation tubes into the tunnel.

Adit crews were made up of three men and one foreman per shift, two shifts per day, for the first 1500 ft of tunnel driving. After that one man was added to each shift. The shift working cycle, although not always maintained, was to muck, drill, load, and shoot. Each crew was responsible for advancing the air, water, and ventilation lines.

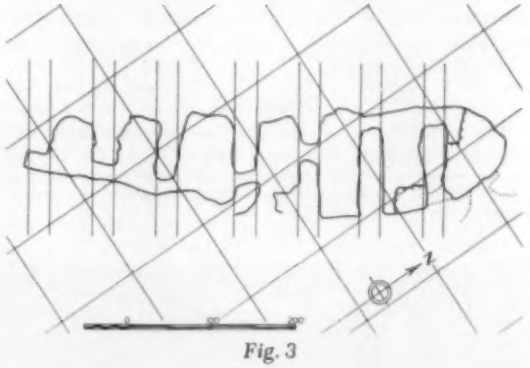

Fig. 3

Mining Method: The modified room-and-pillar mining plan divides the orebody into a series of open-stope levels, separated by floor pillars approximately 40 ft thick. Each stope-level consists of two slices as shown in Fig. 2. The level is divided into rooms 40 ft high, 50 ft long, and the width of the ore zone. Fig. 3 shows an actual plan view of a stoping area utilizing the room-and-pillar method. The rooms on each level are separated by vertical pillars 25 ft thick extending across the orebody

and aligned one above the other from level to level. Drifts through these pillars provide access between rooms (Fig. 3). Access from the adit into each level is made through two crosscuts for each level (Fig. 2). The upper crosscut enters the stope 15 to 20 ft below the back; the lower crosscut enters at the floor of the level which, in turn, is 20 to 25 ft below the top crosscut.

The first step in mining a level is to remove a 15 to 20-ft slice from the top of each proposed room. This is accomplished by working from the upper access crosscut with breast stope mining. For the most part, slab rounds are used to extend the slice over the full area of the room. Drift rounds are used to cut passageways through the vertical pillars, and each of these drifts is held to one wall of the orebody. To minimize weakening of the pillars, drifts are driven on footwall and hanging wall alternately. The breast stoping on the upper slice of the level is advanced as rapidly as possible until directly above the lower access crosscut, and a connection is made between the two.

When the upper slice reaches its full dimensions and the connection with the lower of the two access crosscuts made, the lower slice is removed by benching with vertical holes from the upper slice to the floor of the lower slice. No actual driving is done on the lower slice, except for the original access crosscut from the inclined adit and access drifts through the pillars to other rooms. Before the lower slice is mined, the back is scaled thoroughly and made safe. Roof bolts are put in if needed, although very few have been used to date.

When the benching is completed in one room, a drift is driven through the lower portion of the vertical pillar and along the wall opposite the one through which the drift was driven on the upper level (Fig. 3). With this new drift serving as a haulageway, the benching of the second room begins and is carried on in the same manner as in the first room. The steps of drifting through the vertical pillars and benching are repeated until the entire level has been mined out.

Drilling in the breast stoping areas and in access drifts is done by a truck-mounted three-jib jumbo and a two-machine tractor-mounted jumbo, each equipped with 3½-in. drifters using 1¼-in. round steel and 1⅞-in. carbide insert bits. Standard 10-ft blastholes are drilled and loaded with a gel powder of 40 pct strength, fired with electric caps using regular delays. The broken ore is loaded into 8-ton Dumptor trucks either by an overhead loader or by a front-end loader.

Benching is done with a track-mounted wagon drill. Carbide insert bits on sectional steel are used to drill 2½-in. diam vertical holes, spaced approximately 6 ft apart and drilled about 30 in. below the toe of the bench. Each hole is plugged, for later blasting, with a short casing containing a wooden plug. Fly rock from blasting is pushed into the muck pile by a bulldozer, after which the ore is loaded into the trucks with a ½-cu yd diesel-driven boom shovel. In places where there is not enough space to use this shovel, an end loader or overhead loader is substituted.

The lower orebody, which is offset and parallel to the upper, is being mined by advancing a haulage drift along the lower edge of the ore. From this drift, breast stope mining will progress up dip. Broken ore will be slushed or bulldozed down dip to the haulage drift to be loaded into trucks and conveyed directly to the mill.

Mining is done on one shift with a labor force of 13 men—one mine foreman, five drillers, one powder and roof man, two shovel operators, and four dump-truck drivers.

Mine water drains through the stope and down the adit to a central sump, from which it is pumped to surface via the 16-in. churn drill hole. This churn drill hole accommodates an 8-in. discharge line and the power cable supplying the pump motors. The short-coupled 6-in. turbine pump and a 5-in. four-stage centrifugal pump handle approximately 500 gpm under a 450-ft head. A system of float switches have been installed to allow for fluctuations in flow of ground water.

A downward flow of air through the ventilation raises driven between the stoping levels within the mine is maintained by a 6000-cfm blower-type fan on the surface. Where the ventilation raises are not naturally downcast, auxiliary blowers are used to force the fresh air into the lower workings. The adit serves as an exhaust airway.

THE MILLING OPERATION

The character of the ore from the Bowers-Campbell mine permits using a simple flowsheet in the milling operation. Ore is trucked to the mill directly from the mine stope and dumped on a bar grizzly with 20-in. spacing. A 36-in. apron feeder delivers it to a 21x36-in. primary jaw crusher. The crushed ore is carried by a 30-in. belt conveyor to a double-deck shaking screen equipped with a ¾-in. wire screen on the lower deck. The −¾-in. material is then carried on a 24-in. conveyor to an 800-ton ore bin and the +¾-in. material is fed into a 4-ft standard cone crusher which is in closed circuit with the screen. The −¾-in. ore is drawn from the 800-ton

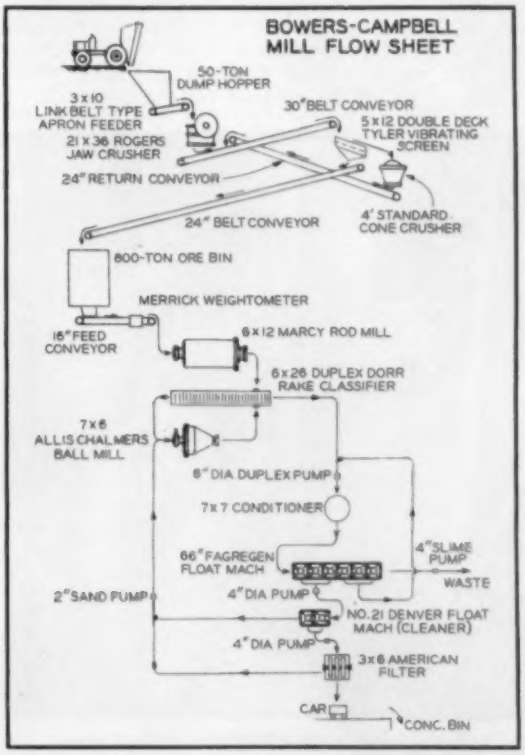

Fig. 4—Ground-level view of the adit entry (center), mill (left) and crusher plant (right) at the Bowers-Campbell mine. In foreground from left to right are the author, C. A. Pugh (mine foreman), and H. G. Scott (mill foreman).

bin onto a 16-in. conveyor equipped with a weightometer and is discharged into a 6x12 rod mill. Discharge from the rod mill passes to an 8-ft duplex rake classifier, which is in closed circuit with a 7x6 ball mill. Classifier overflow, approximately 95 pct −40 mesh, is pumped by a 6-in. duplex diaphragm pump to a 7x7-ft conditioner. From the conditioner the feed passes to the flotation machines, which consist of six 66-in. rougher cells and two 21-in. cleaner cells. The zinc concentrate is dewatered with a three-leaf, 6-ft filter.

The mill operates 24 hr per day and processes on the average, 750 tons of ore daily. Total labor force for the mill consists of ten men—one mill foreman, two crusher men, three flotation men and three helpers, and one man to load and haul the zinc concentrates to the railroad car for shipment to the St. Jospeh Lead Co.'s smelter in Josephtown, Pa.

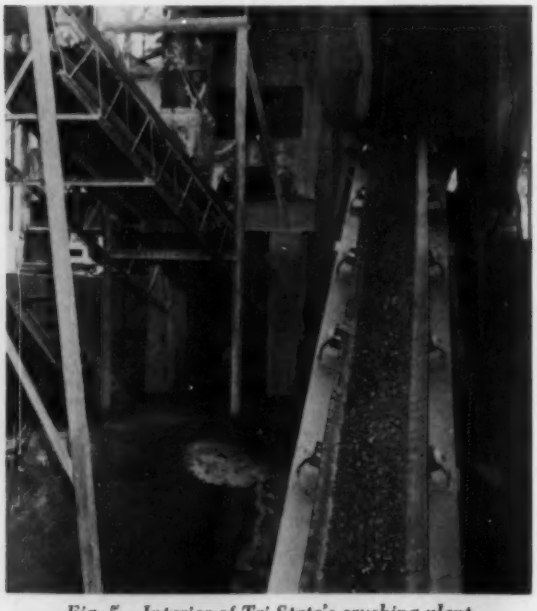

Fig. 5—Interior of Tri-State's crushing plant.

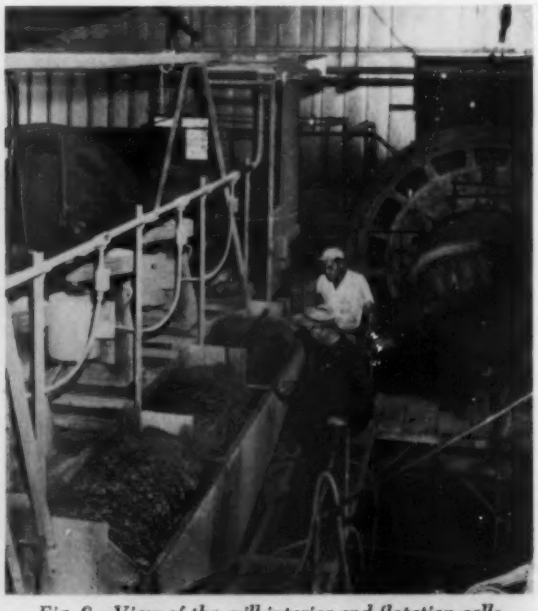

Fig. 6—View of the mill interior and flotation cells.

THE DIGITAL COMPUTER— APPLICATIONS IN MINING AND PROCESS CONTROL

PETER B. NALLE and LEROY W. WEEKS

The rapid growth of the modern electronic computer industry during the past 15 years is, perhaps, the greatest phenomenon that has occurred in American business in this century. This growth is due in part to the new, and in some instances, revolutionary applications of computers instigated and developed by both the manufacturers of such equipment and their customers who search for easier, faster, more accurate methods of conducting their business operations.

As in other industries, modern computers are becoming more common in the field of mining. The adaptation of computer analysis to the unique problems of mining companies is undergoing research and development by both electronic and mining companies. However, for those of us in mining who are interested in the possibilities of computer analysis and control, the basic question is *Where can a computer system be of use in a mining operation today?* Some ideas of such applications follow, as well as a specific example of computer control at the Riverside Cement Co.

APPLICATIONS TO MINING

Within the mining industry, a computer is basically suited to three types of work:

1) Relatively simple problems which occur many, many times in the same form.
2) Long, complex problems.
3) Process control.

Simple Problems: To handle relatively simple problems which occur repetitively in the same form, a program can be written so that the information is fed to the computer in a standardized form and the answer comes out in a standard form. Many examples of this type of computation can be given from other industries. Payroll computation, cut-and-fill calculations for highway construction, stadia reduction, statistical studies, and insurance policy computations are but a few examples. Unless a company has a very large volume of work, a specific series of computations of this sort would not usually justify the use and expense of a computer. However, as more and more of the series come into being, serious thought can be given to utilizing a computer.

Editor's Note: The digital computer is described on page 1002.

Three typical mining problems of the "many times" type are suitable for a computer. For an open pit operation, all calculations concerning tonnage mined and tonnage remaining (by benches and areas) plus grades of ore and other operating data, could be obtained by giving a computer a series of survey notes, mill heads, and drillhole data. For a computation that occurs once a year or less, it might not pay to write a program for such a problem. However, for problems that occur monthly or at greater frequency, a program of this nature might be very valuable, especially for a company which operates several open pit mines.

A second type of problem concerns drill core data logging and reserve calculations. Certain drilling programs, especially in bedded ore and in very large deposits, are well suited to computer analysis. The analysis can go as far as necessary into a statistical study of basic data. (See R. F. Shurtz: *The Electronic Computer and Statistics for Predicting Ore Recovery.* MINING ENGINEERING, Oct. 1959). A final example of the "many times" problem is the payroll calculation for a mine that uses a fairly complex contract or bonus system for its workers. From the same series of calculations, both the accounting and engineering data needed could be developed.

Complex Problems: A second general type of problem well suited to computer analysis is one which is either so long or so complex that it cannot be solved economically with a desk calculator. Problems of this sort appear often in any type of operations research or study involving linear programming. Engineering design problems also generally fall into this category.

Haulage studies, delineation of open pit bench layout and mining limits, or milling of a complex ore of varying grades for maximum dollar recovery are examples of complex mining problems. Only general examples of problems can be given because 1) the field is so new and growing so fast, and 2) because the problems differ radically for different business firms.

Process Control: A third use of digital computers in the mining and milling field is for process control. Oil refining and chemical industries have made a start in this field. Today, a digital computer is being used to control a polymerization unit in a Texas refinery. Digital computers monitor the operation of steam-generating plants, and the actual control of power plants by computers is being planned.

This type of control has many advantages over the control of a process either by an individual or by many small closed instrument loops. In the first place, a computer will think faster and make more accurate decisions within a specified area than a human. Naturally, the computer cannot replace the human reasoning required for situations which fall outside the established ground rules, but for normal operations computer control has proven better than human supervision.

In addition, the computer can, by continuously considering many variables, seek and find the optimum control set-points for the process. For instance, it can determine maximum output within a given

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THE DIGITAL COMPUTER

A modern digital computer is no more than an extremely high-speed adding machine with certain distinct features. It can store numbers in a memory, and it can store instructions as to the sequence of operation of the successive additions and subtractions. Certain operations such as *multiply* are built into the machine; as a computer becomes more complex, a greater number of these built-in operations are available to the user of the machine.

The *programmer* is the person who puts instructions (called the *program*) into the computer. The program, designed for a specific problem, directs the computer through the correct sequence of operations for the solution of the problem. The analogy has been made that a computer is a very fast clerk with a large file and an adding machine.

Components of a Digital Computer

The digital computer is made up of a number of components. The *control unit* determines the sequence of operations much as the clerk does in the hand calculation. The *arithmetic unit* does the work of the adding machine. The *storage*, or *memory*, unit contains the instructions to be performed, the data to be used, and possibly the results of the computation ready to be printed out. *Input-output* units take the place of an office boy who delivers the problem to the clerk and waits for the solution so he can take it to the person concerned. A digital computer that is to be used for process control may have an *analog-digital converter* as an integral part, or as auxiliary input-output equipment.

Input-output equipment is used by the computer operator to communicate with the computer. Electric typewriters, punched paper tape units, punched card equipment, and magnetic tape units are all used, depending upon the size and type of installation. A small to medium size installation might use an electric typewriter which has provisions for punching and reading paper tape. Magnetic tapes are usually the fastest input-output media, and they are often used where there is a large amount of input and/or output information. The data can be transferred from punched cards to magnetic tape, or vice-versa, by auxiliary equipment while the computer is working on another problem. Digital information can also be read into the computer by means of switches, digital clocks, or other equipment, and digital output signals can be used to turn switches or lights on or off.

The memory unit is the part of the digital computer in which instructions and data are stored, ready for use by the arithmetic and control units. A storage location, called a *word*, has an *address* as a means of identification. A word may be a binary number, or a binary-coded decimal number. The size of a word in different computers may vary from the equivalent of a five-digit decimal number to a ten-digit decimal number, or larger. The number of words available may vary from a few thousand to several million. The words may be stored as magnetized spots on a magnetic drum or disc, or on an array of cores made with small beads of ferromagnetic material. Numerous other types of memories are also in use.

The memory is classified as being *random access* if the same amount of time is required to bring any word from memory into the arithmetic or control unit. Magnetic core memories are random access. A *cyclic* memory, such as magnetic drum, has a given word available for reading only periodically and a variable waiting time will result whenever this word is needed. The memory is considered to be *volatile* if power is required to maintain the information in the memory. Electrostatic and mercury delay line memory units are volatile. Magnetic cores, and usually magnetic drum memories, are *non-volatile* because power is not required to maintain the information in the memory unit.

The arithmetic and control units provide the equipment for controlling and carrying out arithmetic operations. One or more *registers* are included in this portion of the computer. They may consist of electronic circuitry, or they may be a portion of the main memory. The registers are used to temporarily store information, such as the numbers being operated on, the instruction being performed, or the "address" of the next instruction. The arithmetic and control units contain circuitry for decoding and recognizing the operations which the computer is designed to perform. Computers are available which can perform as few as 16 different operations, while others perform 100 or more. Typical operations are add, subtract, multiply, divide, transfer on zero, transfer on negative, shift right, shift left, store in memory, bring from memory, input from punched paper tape, and output to typewriter.

Selection of a Digital Computer

Many computers are available today. Any journal on computers gives advertisements and descriptions of currently available makes. It would be impossible to designate a specific computer for all purposes because, like mining machines, certain ones fill certain needs. A few of the features generally considered in selecting a computer are:

1) Speed of operation—for simple problems great speed may not be necessary.

2) Reliability—a computer to be used for "on line" process control must obviously be very reliable.

3) Size of memory—certain jobs or problems require a much larger memory or "filing" area than others. Also speed of access to the memory must be considered.

4) Size of word—some computers can handle larger numbers (hence, words) than others.

5) Complexity of the logic section, or number of commands available—increasing the number of commands make short cuts available to the programmer and can speed up the operation of the computer and shorten the program. A complex logic, however, is not essential to solving complex problems.

6) Input-output devices—the speed and complexity of the communication system will depend on the use to which the computer will be put.

Peter B. Nalle and Leroy W. Weeks

 (Continued from page 1001)
quality range, or maximum quality consistent with a given output. Individual instrument loops cannot do this job to the same degree as a computer.

COMPUTER CONTROL AT RIVERSIDE

Early in 1958, Riverside Cement Co. rented a large computer to do a linear programming study on possible raw material sources. At about the same time, the Ramo-Wooldridge Corp. finished a study on the possibility of automating a part of the cement manufacturing process at Riverside's Oro Grande deposit in Southern California. Early in 1959 a complex storage pile system was put into operation so as to make a more uniform kiln feed and to free the mining department from the requirement of supplying hour-by-hour variations in feed. An analysis of the mix problem, the possibility of controlling a kiln by a computer, and the results of the trial run in 1958 indicated that a computer could be put to good use.

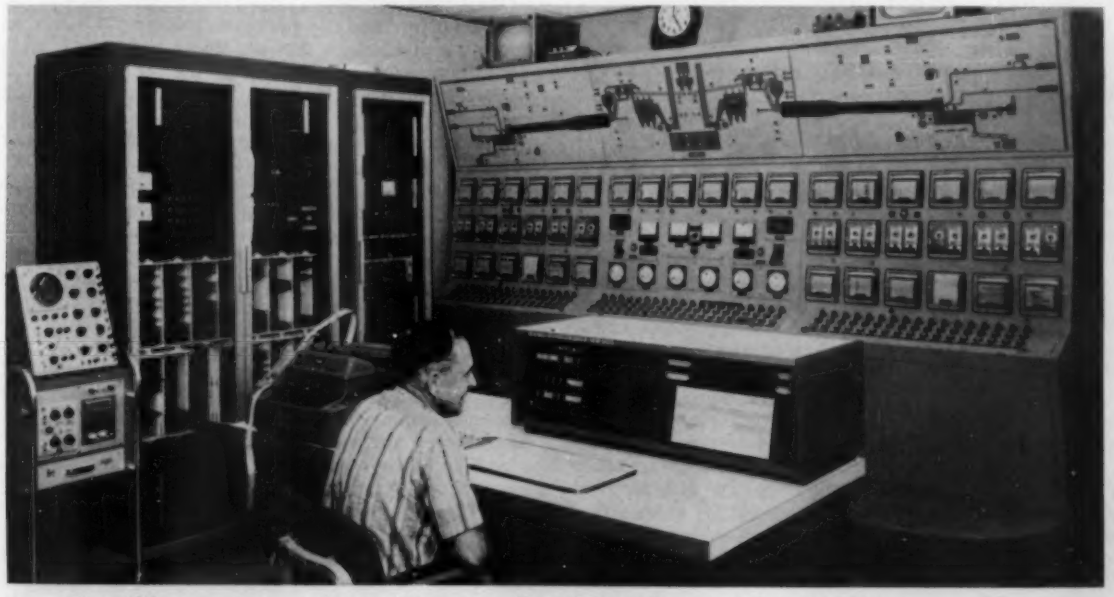
The computer purchased is an RW-300 process-control computer marketed by The Thompson-Ramo-Wooldridge Products Co. It is a general-purpose digital computer with the analog-to-digital and digital-to-analog conversion equipment as an integral part of the unit. It has a magnetic drum memory with a capacity of approximately 8000 words. A Flexowriter, which is an electric typewriter combined with a paper-tape punch and reader, is used for input and output of data. An operator's control panel is also used for data input and for controlling the sequence of calculations.

Cement Manufacturing Process: Before discussing the use of the computer for the mix calculations, it may be well to give a brief description of the cement manufacturing process. Portland cement is made by mixing raw materials and grinding them to a fine powder or slurry. This raw mix is burned to incipient fusion in a rotary kiln to produce *clinker*. The clinker is cooled and, with the addition of a small percentage of gypsum, it is ground to form the finished cement product. Specifications for the various types of Portland cement generally prescribe certain chemical requirements as well as the other requirements of strength, soundness, etc. The specifications include maximum or minimum percentages of certain oxides and of compounds such as tri-calcium silicate and tri-calcium aluminate allowed in the finished cement.

In the manufacture of cement of uniformly high quality, it is important that the percentages of oxides, and therefore of potential compounds, be carefully controlled. If the raw materials are fairly uniform in composition, the mix control problem may be relatively simple and few chemical analyses need be made. If, on the other hand, the raw materials are variable in chemical analysis and if, for instance, some of the materials contain calcium oxide in the form of calcium carbonate and others in the form of calcium silicates, the mix problem may be complex. At Oro Grande the raw materials are analyzed for the percentages of SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, and loss (largely CO_2). The problem is to blend materials so that the resulting mix has a certain average chemical analysis.

Chemical analyses of specific materials available are required for making the mix calculations. A comprehensive program of diamond drilling of the quarry areas has been completed, and chemical analyses of the drill core provide general information. Samples are taken from blasthole cuttings during quarry operations to furnish daily information regarding materials immediately available.

Computer Use at Riverside: The rock storage facilities at Oro Grande provide space for the building of four piles of blended material, each containing 35,000 to 40,000 tons. The raw materials are hauled by truck from the quarries to a 60 in. gyratory primary crusher, and thence through a set of two hammerhill secondary crushers. The resulting $-\frac{3}{8}$ in. product is transported by conveyor belt to one of four blending piles. A stacker, traveling continuously back and forth over the length of the pile, builds each pile approximately 500 ft long and 36 ft high. From the pile, a reclaimer is used to send the mix by conveyor belt to the grinding mills. Since the reclaimer starts at one end and slowly works



Riverside's computer control room. Computer cabinet, left; analog input cabinet, right rear.

along the entire length of the pile, the material going to the mills is a uniform blend of material within the layered pile.

The crushed material is weighed on belt scales and automatically sampled before going to the stacker. Thus each sample represents a known tonnage of material that has been placed on the pile. The chemical analysis can be used to calculate a weighted average chemical analysis of the pile.

Various methods can be used to calculate the amounts of available materials that will build a pile of the desired average chemical analysis. For example, a set of six simultaneous equations could be set up and solved. This problem would be tedious to solve with a desk calculator but could be done easily with a digital computer. If a computer is available, it is better to use the rather recently developed method called *linear programming*.

Linear Programming at Riverside: Linear programming is a mathematical method for finding an optimum solution to a problem which has a number of possible solutions. As applied to the mix problem, this method will determine the lowest-cost combination of materials which can be combined to give a specified mix. The problem is set up by specifying the proportions of oxides desired in the mix plus the chemical analysis and cost of each of the raw materials that are available. In general, the number of source materials available is greater than the number of oxides specified, thus permitting more than one combination of materials to be used to make the mix. If the number of materials available is equal to the number of oxides specified exactly, there is usually only one solution. If there is no solution with a certain combination of specifications and materials, the linear programming method will indicate the reason for this—that is, it will show which oxide is not present in large enough percentages in the available materials.

When using the linear programming method, it is possible to specify either definite values or ranges for the relative amounts of the oxides in the mix. For instance, we might specify a mix of the following chemical analysis:

SiO_2 between 23.3 and 23.5 pct

Al_2O_3 exactly 5.3 pct

Fe_2O_3 exactly 3.5 pct

CaO between 64.0 and 65.0 pct

MgO not exceeding 2.5 pct

Na_2O not exceeding 0.6 pct

The solution would show the *lowest-cost combination* of materials that will meet these specifications.

In actual use, a problem is set up for each pile before the pile is even started. The specifications for the pile are fed into the computer, along with the chemical analysis and the cost of each type of raw material available. The solution to the problem shows the lowest-cost combination of these materials, and the tonnage of each that should be used. Quarry operating personnel can then work out a schedule for hauling these materials from the quarries. At intervals during the period of six or seven days that is required to build the pile, it may be desirable to set up a new problem to determine what materials are needed to finish the pile. This may be necessary 1) when a certain material hauled from the quarry has a chemical analysis different from that predicted, 2) when a certain type of material is no longer available, or 3) when additional materials have become available. The new problem would use the information obtained from samples of materials already placed on the pile.

An example of a typical problem is shown in the accompanying table. Twelve materials are shown as being available. Solution No. 1 shows the lowest-cost combination, and solutions Nos. 2 and 3 show the next lowest-cost combinations. Solution No. 4 shows a much higher cost. Any one of these solutions might have been worked out by some type of hand calculation, but without the use of the linear programming method it would be difficult to determine the combination with the lowest possible cost.

Table I. Tons of Materials to Make 20,000 Tons of Clinker

Material	Relative Cost per Ton	Tonnage Required, Solution No. 1	2	3	4
Limestone	50				13,248
Limestone	6	23,422	23,452	21,352	
Siliceous Limestone	6			3,052	10,796
Magnesian Limestone	6	2,592	3,028	3,232	3,340
Shale	6	1,469			
Shale	6		616	1,944	1,894
Shale	6	2,573	2,866		
Clay	89	371	522	992	992
Iron Ore	90	395	396	303	336
Total *Relative* Cost		1.00	1.05	1.20	3.51

Besides using the results from linear programming problems for scheduling daily operations, they can be used in long-range planning. The most economical overall use of raw material deposits might be calculated. There are, of course, many other applications for linear programming methods. Problems related to purchasing, production, and shipping may be formulated so that the solution would show how to obtain lowest-cost production, highest total production, highest profit, or some other goal which may be desired.

SUMMARY

Use of the computer for solving cement mix problems over a period of several months has shown that those familiar with the problems associated with quarry operations and with making cement raw mix have had little or no difficulty learning to use the computational system. Use of the computer does not relieve those in charge of quarry operations of the responsibility of making decisions. However, it does give them more information to help in making decisions by performing complex mathematical computations quickly and accurately. Using the computer, it is possible to experiment on paper with the use of certain materials formerly considered to be waste. The speed and ease of computation make such research work possible.

It is expected that before long the computer will be monitoring and actually controlling portions of the cement manufacturing process at Riverside. In the meantime, it is helping to make possible the blending of raw materials to provide a uniform raw mix. Use of the results of linear programming problems in scheduling daily and weekly quarry operations has brought about more efficient use of quarry equipment and manpower. Of primary importance, the continued use of the computer should result in a longer life of the deposits now mined by Riverside Cement Co. for their raw material content.

DATA PROCESSING BY MACHINE— ASSET AT THE MINE SITE

GEORGE S. KOCH, JR. and RICHARD F. LINK

Machine processing of assay data has been successfully applied at two underground mining operations in Mexico. The speed, efficiency, and adaptability of such machines can be of assistance in modernizing similar operations elsewhere.

About 50,000 assays of mine samples were required in a preliminary investigation of the distribution of gold, silver, lead, copper, and zinc in two large Mexican mines, the Frisco mine at San Francisco del Oro (Chihuahua) and the Fresnillo mine at Fresnillo (Zacatecas). The feasibility of working with so many assays rests directly on the use of machine processing methods. The purpose of this article is to describe the methods used because machine (or *data*) processing can also be used efficiently to make the many calculations from mine assays needed in mining operations. No particular originality is claimed for these methods, which are straightforward applications of standard procedures for machine processing.

Inasmuch as machine processing is essentially a routine job once it is begun, procedures must be organized more completely than is the case where human judgment can be inserted at every step. Before undertaking any work, it is necessary to decide carefully just which data must be processed as well as the exact results desired.

Processing operations are carried out by machines which can do the following:

1) Perform the usual arithmetic functions such as addition, subtraction, multiplication, and division (Calculating Punch).
2) Sort (Sorter).
3) Tabulate (Tabulator).

All data must be punched onto the familiar IBM-type key-punch card before they can be processed. This step is perhaps the most tedious and, depending on the extent of subsequent processing, the most expensive of all the steps involved. It is carried out by using a Card Punch and a Card Verifier.

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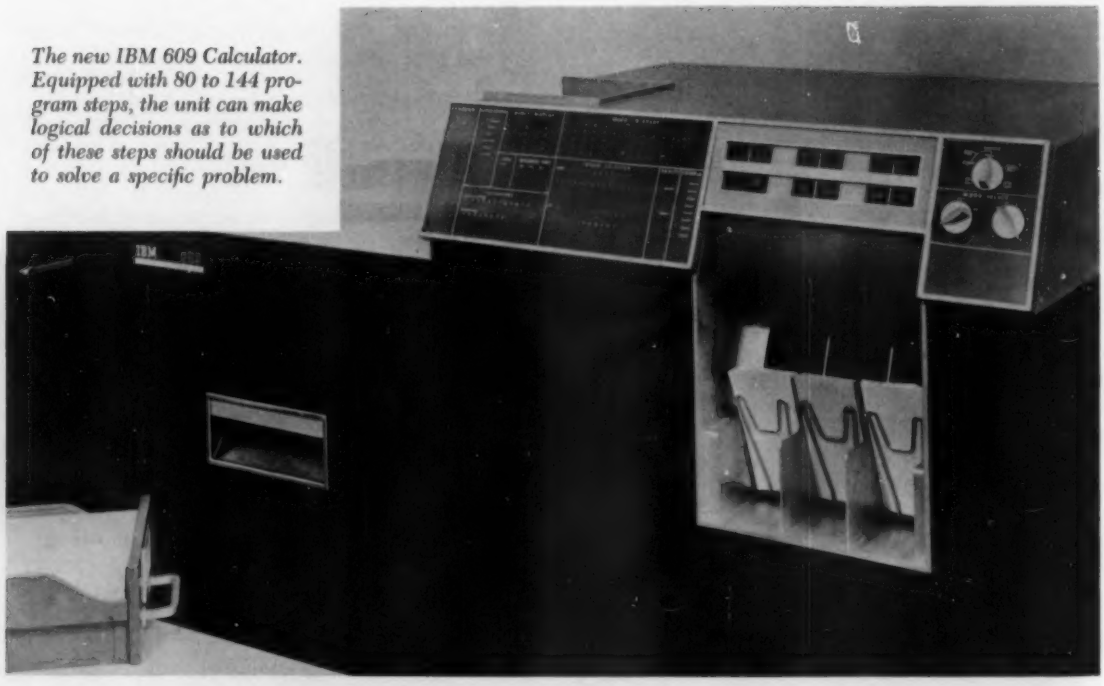
PROCESSING METHODS EMPLOYED IN MEXICO

Preparation of Data for Processing: Both of the Mexican mining operations investigated work fissure veins that are sampled at intervals of two meters (about six ft) in drifts, raises, and at various places in the stopes. A typical medium-sized vein with an area, as measured in longitudinal section, of 0.25 km^2 (0.1 sq mile) contains about 4500 samples of which almost half are drift samples. The original assay data were most readily available from level maps, from longitudinal sections of stopes, and from cross sections of raises. Cards were punched directly from these maps. For each sample, the following was recorded: vein width; assay data of gold, silver, lead, copper, and zinc; mine coordinates; elevation. A card was punched for each sample; this required approximately 38 digits per card to record the above data plus a code number. Mine coordinates and elevations of sections were not, of course, written for each sample on the original maps and sections. At commercial rates, it would cost about 8¢ a sample to transfer the original assay data to the punched cards, or about 5¢ a sample if only the assay data from the level maps had been used and the less accessible data from the stopes and raises omitted. This includes the cost of verifying the punched data.



The new IBM 609 Calculator. Equipped with 80 to 144 program steps, the unit can make logical decisions as to which of these steps should be used to solve a specific problem.

Calculation of Mineral Content: After the initial punching, the cards were machine-processed to obtain the contents of the vein at each place, i.e., the value of each assay multiplied by the vein width. At the same time, the following additional data of scientific interest were obtained: assay of combined base metals, approximate sulfur assay, combined base metals content, silver-zinc ratio, lead-zinc ratio. This work was done on an IBM Calculating Punch. At commercial rates, this processing step would cost about 0.25¢ per sample for calculating the contents for the five metals.

Additional Processing: The remaining processing will be described only briefly because it is not directly applicable to processing assay data for mine reports. However, it does indicate the type of information that can be readily obtained from the assay data once they are punched on cards and demonstrates methods of interpreting the data of scientific interest and of potential commercial value.

Most of these calculations were done on an IBM Electronic Statistical Machine. This machine does only three things. First, it sorts cards into categories; for example, all assays with more than 10 pct zinc content can be segregated from the others, or all samples with a given ratio of lead-to-zinc can be segregated from the other samples. Secondly, this machine counts cards. For example, it will count the number of cards having copper values of 0.5 pct, 0.6 pct, 0.7 pct, etc. Finally this machine can add, for instance, the silver assays on two cards, ten cards, or a thousand cards. Thus the machine is "simple-minded" but, since it processes 450 cards a minute, it can rapidly extract much useful information. In 10 min 4500 cards can be processed for a medium-sized vein 800 m (2400 ft) long and 400 m (1200 ft) deep. This enables the mining department to make many calculations which, by using conventional methods with desk calculators, would be too expensive, tedious, and time-consuming to be feasible, even when low-cost labor is available.

Using the IBM Electronic Statistical Machine, the cards for each vein were machine-sorted into groups representing a grid of squares 20 meters on a side superimposed on a longitudinal section of each vein. The vertical coordinate is the elevation and the horizontal coordinate is a trigonometric function of the mine coordinates. For the two veins initially studied at the Frisco mine, this resulted in 620 groups. The data in each group was then machine-processed to obtain the averages for the data points within each square. These averages have been plotted on maps and contours drawn to show the zoning of metals, which have definite patterns of mineralization at various places in the veins.

For some purposes, it was more desirable to draw such contour maps using an equal number of samples in each square rather than squares of equal size as described above. The IBM Electronic Statistical Machine can also be used to furnish such data. The following procedure is described to again illustrate the versatility of the machine. First, the key punch cards representing the samples were arranged in order by sorting according to the increasing value of one coordinate. The machine then can be made to average the data for each group of ten cards by counting and adding ten cards, printing a total, and automatically repeating this procedure with the next ten cards. This sort of preliminary averaging is commonly done in blocking ore to determine block lines.

ADDITIONAL APPLICATIONS TO MINE OPERATIONS

To set up a system of machine processing of mine assay data at an operating mine, existing assay data still in use would need to be punched on cards. As described above, the cost of this punching would be about 8¢ per sample for five metals. New assay data could be punched on key-punch cards at a cost of about 4¢ per sample. There are at least three good ways of recording new assay data on such

cards. These are mark-sensing, direct hand-punching, and machine-punching. Perhaps the easiest is the direct hand-punching of special cards using a stencil and stylus. These cards can be punched by assay office personnel as rapidly as assays could be written out by hand. Mine coordinates and elevations can also be punched on the same cards after the sample locations had been determined in the geological or engineering office. These original data are the only ones that would need to be punched by an operator. All subsequent steps would be done automatically by machine.

Routine Reports: Daily or routine assay reports would be prepared from the punched cards by the use of an accounting machine. These reports on an appropriate preprinted form would contain the standard information of sample numbers, widths, assay values, and locations. In addition, useful data that is generally omitted from daily assay reports because of the time taken for their computation could readily be supplied through calculation using a Calculating Punch. Such items are metallic content (widths x assays), content adjusted to minimum stoping widths, dollar values, subtotals and grand totals for assays from various working places, and averages. Assay lists required at other reporting periods, such as monthly, quarterly, or annually, would be prepared in a manner similar to that used for the daily assay reports.

Computation of Ore Reserves: Calculation of ore reserves would be greatly facilitated by the use of these machine data-processing methods. In a typical vein mine, calculation of ore reserves first requires location of ore shoots on levels. This is commonly done by scanning lists of drift assays written on assay maps—a laborious procedure particularly where several metals contribute significantly to the value of the ore and where metal prices (or liquidation values) fluctuate widely. For instance, the sample cards could be arranged in sequence of assays from one end of a drift to the other. In addition to the assay data originally punched for the individual sample, each card would contain the contents (width x assay) for each metal, adjusted if desired, for the minimum stoping width and dilution factors. Dollar value of the sample could then be computed using the particular metal prices in effect at that time, or those projected for a future period.

If the minimum number of samples establishing a minable ore shoot were five, a data-processing machine could scan cards until a group of at least five was obtained to meet the minimum dollar value required. The machine could also be made to continue scanning cards until their totals fell below the required value. Subsequent processing would yield the total dollar value and indicate the extent of the minable ore-shoot. Subsequent phases of blocking ore—taking into account data from raises, winzes, and stopes—would be handled in the same way as the level data. When the cards, representing samples from a block of ore, were segregated and assembled, they could then be processed to obtain the tonnage of ore in the block, using the appropriate tonnage-volume and dilution factors required.

Data processing methods are cheap and routine enough to permit reblocking of ore whenever costs and prices change. It certainly would allow reblocking of ore zones annually. This is a procedure that is often too expensive and too tedious when using desk calculators. (It is true that the dollar value of existing ore blocks can be readily recalculated annually with desk calculators but the more significant process of re-examining the limits of ore blocks is exceedingly laborious in a typical mine with a few million tons of reserves distributed in several hundred blocks.)

Application of Machine Processing to Other Operations: The methods of machine processing described above would perform operations commonly done with desk calculators. However, the greatest advantage of such processing would be the opportunity to make calculations that are seldom, if ever, carried out at present because they are too laborious for desk calculators. While the specific calculations suggested in this article stem from the experience of one of the authors in a medium-sized base metal mine, the principles could find application at other properties.

First, machine processing would allow reblocking ore so that block limits could readily be adjusted whenever metal prices or liquidation values changed appreciably. Where a mine has a large number of ore blocks, this would make possible a clear decision as to which of them should be stoped at any particular time. Through machine processing, all the mine blocks could be listed in order of dollar value per ton using current values. Management could then go down the list until it reached the first block suitable for mining from the standpoints of tonnage, haulage, labor, supervision, etc. Probably the costs and metal prices used in such calculations will be projected; nonetheless they are values that should be determined immediately before the decision is made where to stope, rather than the values obtained when the ore was blocked. Reblocking would also be used to control stoping, especially where a block of ore decreases in value as stoping progresses so that a question exists as to whether the mining of the entire block will pay.

Secondly, by the use of machine processing, it would be feasible to block ore using modern statistical methods that are more accurate than conventional methods. For example, the tonnage-volume factor varies, of course, upon the specific gravity of the ore which, in turn, varies according to the proportion of minerals present. However, this is seldom, if ever, taken into account at present owing to the wearisome calculations required when done with desk calculators.

Furthermore, once machine processing was installed other applications would suggest themselves, as the authors discovered after gaining experience in processing assays for scientific purposes.

CONCLUSION

The authors believe that machine processing of assay data would pay in medium-sized or larger mines. Suitable machines for processing of mine assay data now rent for about $650 a month. Since these machines would be required for processing mine assay data only a few hours a week, they could be used for other purposes such as payroll and accounting.

This project has been supported financially by the General Research Fund of Oregon State College and by the American Philosophical Society. The authors also are indebted to various colleagues at Oregon State College, in particular Tom J. Minner, for useful advice and assistance. The cooperation of the personnel of the Frisco and Fresnillo mines is also gratefully acknowledged.

ENGINEERS JOINT COUNCIL MISSION TO RUSSIA

The following is an excerpt from a report by the EJC delegation which visited various Russian educational institutes during the four-week period ending July 23. Members of the delegation were: W. E. Lobo, Consulting Chemical Engineer, N. Y.; H. R. Beatty, President of Wentworth Institute, Boston; C. S. Dargusch, Advisor, Engineering Manpower Commission; O. Hoeffding, Economist, The Rand Corp.; S. B. Ingram, Director of Technical Employment, Bell Telephone Laboratories, Inc.; R. M. Mahoney, Manager of Industrial Relations Development, Union Carbide Corp.

The objective of the mission was basically to study the utilization of engineers and engineering technicians and their interrelationship in the Soviet Union. Beginning with their graduation from the engineering institutes and technicums, we hoped to learn how the graduates started out in industry, what their training on the job was, what sort of work they did, and how they worked themselves up within their profession. However, it turned out that, as our host was the Ministry of Higher and Secondary Education, most of our visits were to educational establishments. Our itinerary covered Moscow, Leningrad, Kharkov, Rostov, Baku, and Tashkent, with a side trip to Samarkand. In all, we visited 13 technical institutes, three technicums, and five industrial plants or *enterprises*, as they are called there.

Our trip was one of only four weeks. Our observations were limited by the few cities and enterprises we were permitted to visit. Nevertheless, we did come back with some definite impressions and conclusions which we feel should be of interest to engineers, educators, and those concerned with the relative economic and technical power of the USSR and the U.S.

First, although the quality of engineering education had previously been studied by Korol of MIT and DeWitt of Harvard, as well as by the ASEE team in 1957, we had the opportunity to observe that significant changes have been and are being made in the Soviet Union. Following a 1957 decree, the goal is to admit not more than 20 pct of their high school students directly to higher education; the remaining 80 pct have to spend two years in practical work in industry before being permitted to continue their education. Even the 20 pct directly admitted are required, as part of their education, to spend 16 months in practical work in industry. Furthermore, since so much practical training is being received while working in industry under the guidance of institute faculty members who accompany the students to the enterprises, it has become possible, as well as desirable, to considerably strengthen the theoretical content of the engineering program. Thus, we can say that the engineering education given in those institutes in the USSR which we visited is of high quality. Theoretical and mathematical content is above that generally given in the bachelor programs in U.S. engineering colleges. This is combined with practical specialization to a large extent. Foreign languages and political economy are included in the curricula, but not the more humanistic social courses which we give.

Second, technicums operate an efficient and effective program to produce technicians. The mathematical content of the course work is above that of practically all the technical institutes in the U.S. Representatives of the Ministry of Higher and Secondary Education stated that the USSR is producing 250,000 industrial technicum graduates annually for industry, while we in the U.S. graduate 14,000 to 16,000 annually, of whom not more than 1000 are of the quality of those produced by the technicums we visited. Also, a considerable number of technicum graduates go on in engineering education to qualify as engineers. There seems to be little question that enterprises are utilizing technicians to support effectively the work of engineers in research, design, and production.

Third, although some 108,000 engineers are graduating each year in the USSR, we did get the impression that many are assigned to jobs to which we would not assign engineers in this country. It is not uncommon, apparently, for an engineer on his first assignment to serve as a technician or even in the worker category.

About one third of the students in engineering institutes and technicums are women, who are employed in a wide range of technical positions. It seems, however, that a smaller percentage hold top administrative positions in enterprises and education.

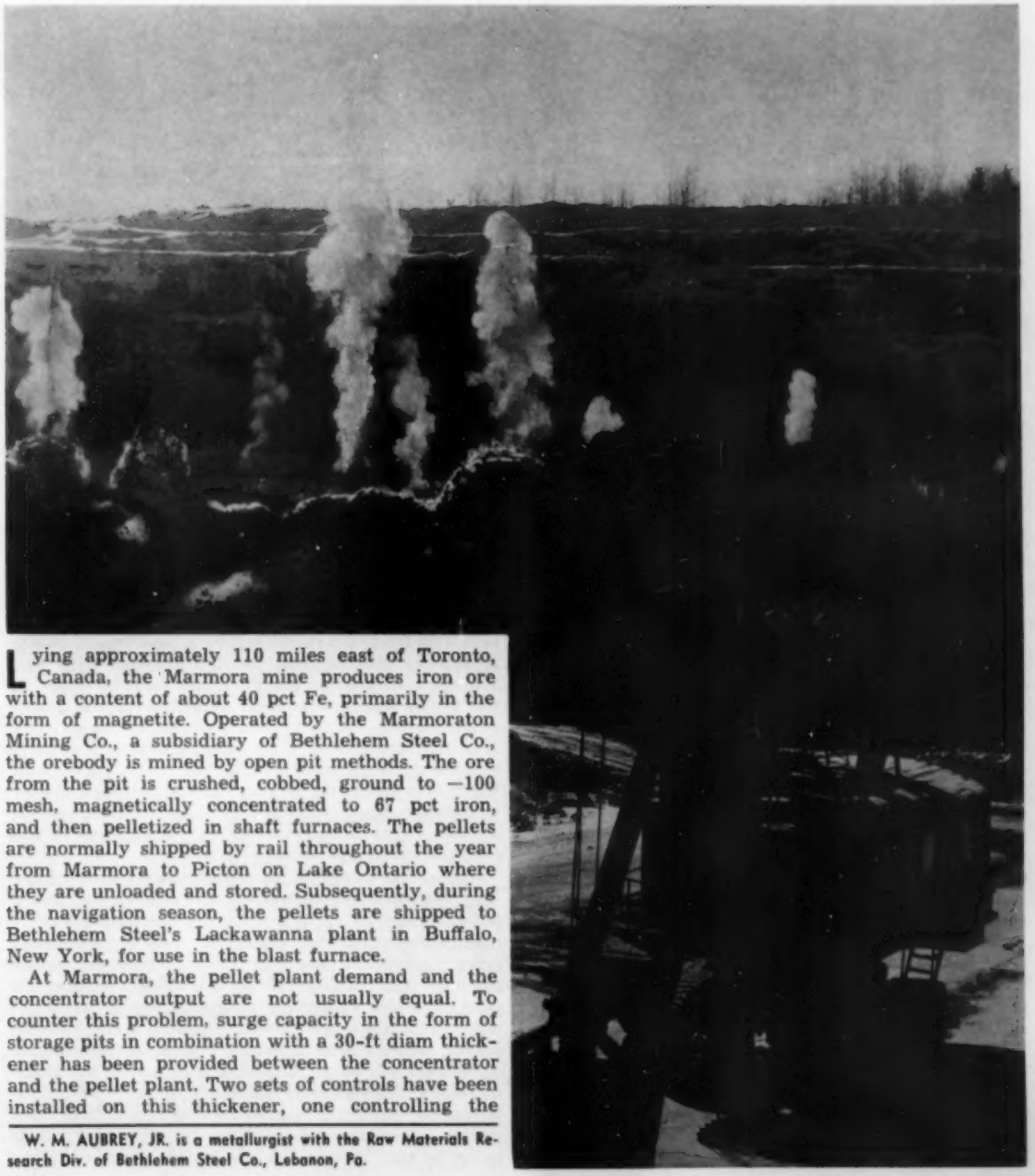
One of the most impressive things was the broad program of continuing education through evening, correspondence, and refresher courses which provide opportunities for large numbers of men and women in all levels to continue their technical education. There is no question that Soviet citizens approach technical education with great seriousness of purpose and real dedication. They know that it is one of the principle avenues to higher status and economic privilege. This results in an extremely high motivation in both institutes and technicums, which helps to account for the very low attrition rates (less than 5 pct in the daytime division, and 10 to 15 pct in the evening and correspondence divisions). Another important motivation factor, of course, is the stipend given 75 to 80 pct of all students on the basis of academic performance. Again, engineering education positions, which usually come only after many years of experience in industry plus post-graduate study, carry more status and financial compensation than industrial positions.

Under the new system all technical education has been closely integrated with industry. In this way the graduates may be effectively utilized by industry immediately after graduation because of the practical work experience obtained at the enterprises during the educational process. The faculties of the technical institutions, aided by their students, are continually called upon by the enterprises to solve many of their problems. This close cooperation is of great benefit to all concerned.

Summarizing, we believe that we can learn something from our visit. We must not discount the technical education which is being given increasingly throughout the Soviet Union. The drive to learn, with appreciation by all of the importance and impact of technology in today's world, is something to which we can well give serious thought. We are in a highly competitive world situation and we want to maintain our position.

AUTOMATIC THICKENER CONTROL AT MARMORA MINE

by W. M. AUBREY, JR.



Lying approximately 110 miles east of Toronto, Canada, the Marmora mine produces iron ore with a content of about 40 pct Fe, primarily in the form of magnetite. Operated by the Marmoraton Mining Co., a subsidiary of Bethlehem Steel Co., the orebody is mined by open pit methods. The ore from the pit is crushed, cobbed, ground to −100 mesh, magnetically concentrated to 67 pct iron, and then pelletized in shaft furnaces. The pellets are normally shipped by rail throughout the year from Marmora to Picton on Lake Ontario where they are unloaded and stored. Subsequently, during the navigation season, the pellets are shipped to Bethlehem Steel's Lackawanna plant in Buffalo, New York, for use in the blast furnace.

At Marmora, the pellet plant demand and the concentrator output are not usually equal. To counter this problem, surge capacity in the form of storage pits in combination with a 30-ft diam thickener has been provided between the concentrator and the pellet plant. Two sets of controls have been installed on this thickener, one controlling the

W. M. AUBREY, JR. is a metallurgist with the Raw Materials Research Div. of Bethlehem Steel Co., Lebanon, Pa.

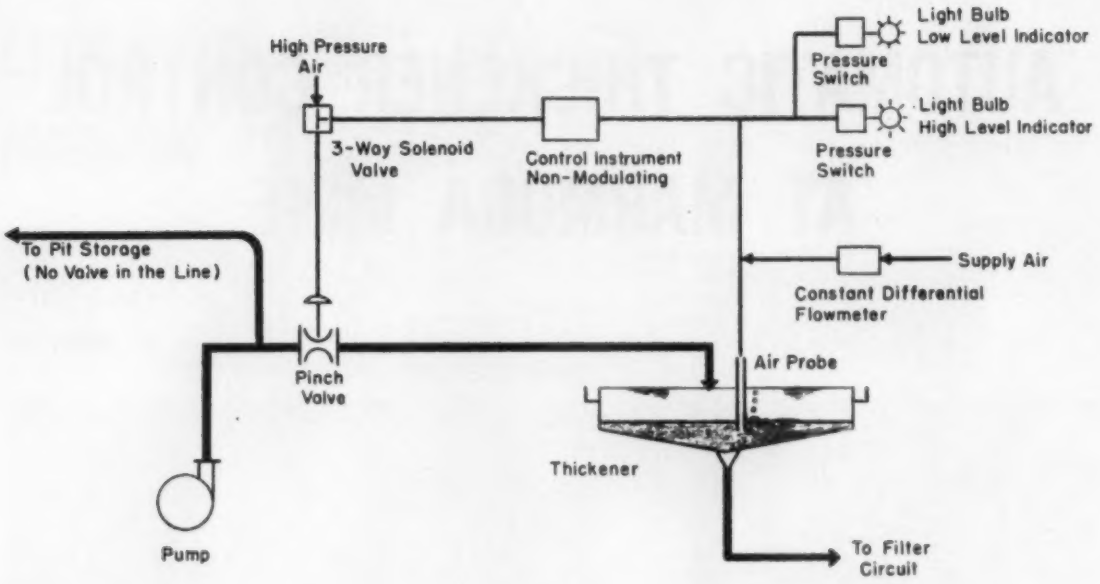


Fig. 1

feed to the thickener and the other, the underflow removed from the thickener.

THICKENER FEED CONTROL

The thickener feed control illustrated in Fig. 1 works as follows: During periods when concentrator production is greater than pellet furnace demand, the concentrate is pumped to the 30-ft diam thickener. As the sludge level rises in the thickener, it is sensed as an increase in back pressure by an air probe. When the sludge level reaches a predetermined upper limit, the control instrument trips a three-way solenoid valve closing an air-operated pinch valve, and the feed is diverted through a bypass to the surge pits.

When the sludge level drops to a predetermined lower level, the control re-opens the pinch valve, returning the feed to the thickener (this level is allowed to oscillate about 6 in.) Maintaining the sludge level within these limits keeps the underflow density quite constant. Modulating controls were not used as the magnetite concentrate is magnetically flocculated and the *on-off* control does not affect the screen analysis of the underflow.

If the back pressure on the air probe is not in the desired range (sludge level too high or too low) a signal light flashes on. The signal light was originally controlled by a mercury manometer equipped with high and low level contacts. This method proved unreliable and has been replaced by two bellows-actuated mercury switches. Otherwise the equipment is as it was installed five years ago.

When the concentrator is not scheduled for operation or the pellet furnace demand is in excess of the concentrator production, total concentrator output is pumped to the thickener and concentrate is reclaimed from the storage pits to make up the deficiency. The decanted concentrate is transferred from the pits to a bin and apron feeder by an overhead traveling crane. It is then repulped and pumped to the thickener. The automatic thickener feed controls are switched to regulate the apron feeder in the same on-off manner.

The feed controls serve the following purposes:

1. They meter into the thickener an amount of magnetite concentrate equal to that being removed for filtering.

2. They maintain within limits the desired sludge level in the thickener, which ensures a thickener underflow of constant density.

THICKENER FILTER CIRCUIT

The thickener underflow-filter feed circuit in Fig. 2 is somewhat more complicated than the ordinary filtering circuit since solid fuel (coal) is added and which must be kept out of the thickener. If it is not, the coal tends to build up in the thickener (probably due to a heavy media effect), giving an erratic coal content in the underflow and filter cake.

The circuit operates as follows: The underflow is removed from the thickener by a centrifugal pump. A splitter divides the pump discharge into two streams; one goes to the thickener and the other, to the sump and pump. Coal is added to the pump sump and the slurry is then pumped to the splitters ahead of the filters. The filter operator manually adjusts these splitters so that the filters produce at the rate equal to the demand of the furnaces. Water is added to the filter tanks by means of float valves, ensuring that a slurry level is maintained in the filters at all times.

The excess material from the hand-operated filter feed splitters is returned by gravity to the pump sump where an air probe senses the pulp level. A modulating controller equipped with an automatic reset mechanism reacts to the back pressure measured by this sump probe by adjusting the position of the splitter at the centrifugal pump so as to always maintain a predetermined sump level. For example, when a filter operator decreases the amount of concentrate being filtered, the return to the sump increases, thus raising the level in the sump. The air probe senses this change and the modulating controller repositions the splitter at the centrifugal pump so that it delivers less to the sump, bringing

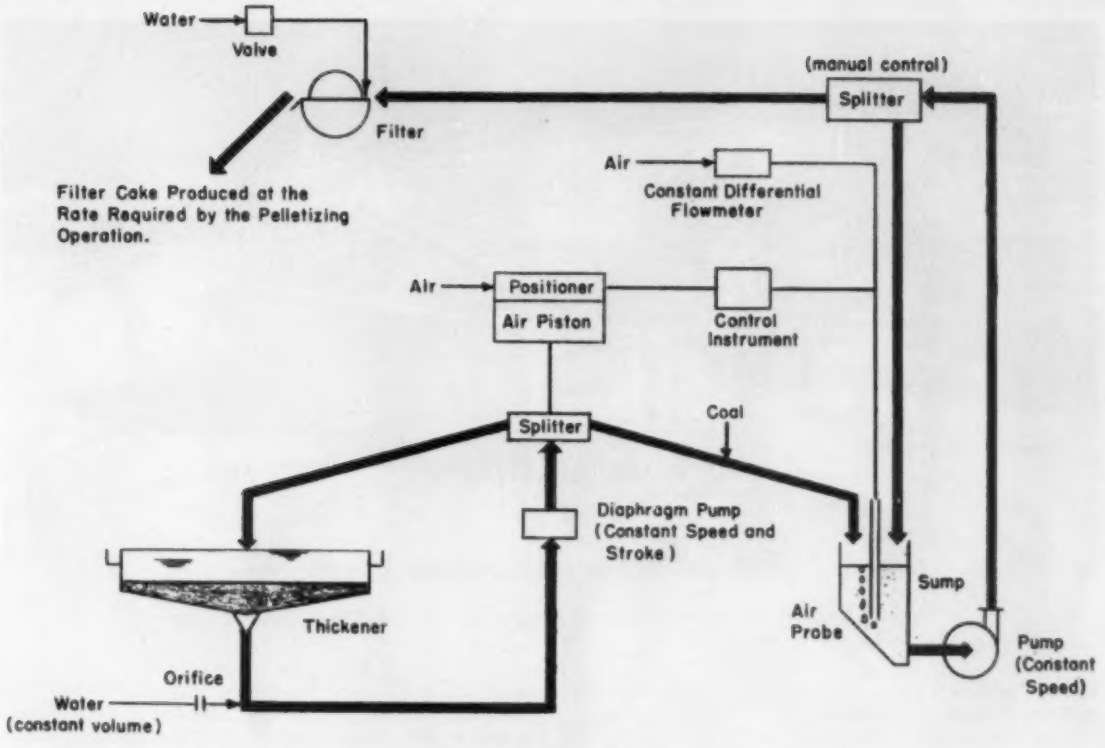

Water
Valve
Filter
(manual control)
Splitter
Filter Cake Produced at the Rate Required by the Pelletizing Operation.
Air
Constant Differential Flowmeter
Air
Positioner
Air Piston
Control Instrument
Splitter
Coal
Diaphragm Pump (Constant Speed and Stroke)
Thickener
Sump
Air Probe
Pump (Constant Speed)
Orifice
Water (constant volume)

Fig. 2

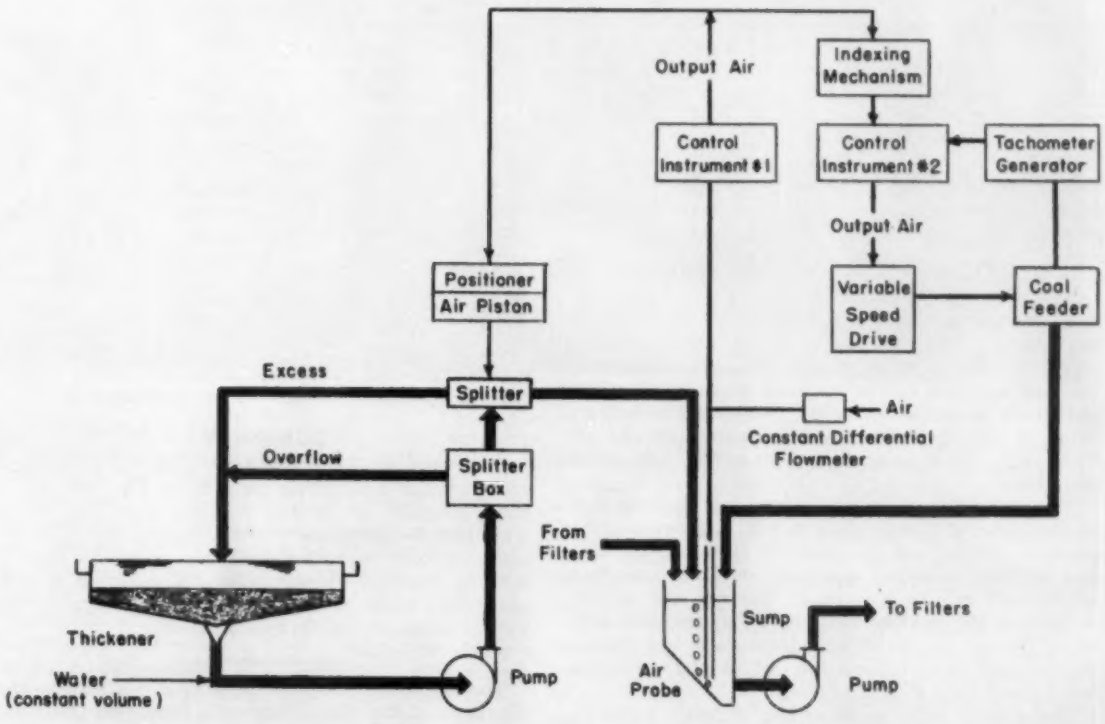

Output Air
Indexing Mechanism
Control Instrument #1
Control Instrument #2
Tachometer Generator
Output Air
Positioner
Air Piston
Variable Speed Drive
Coal Feeder
Excess
Splitter
Air
Constant Differential Flowmeter
Overflow
Splitter Box
From Filters
Thickener
Sump
To Filters
Water (constant volume)
Pump
Air Probe
Pump

Fig. 3

Fig. 4—View of the mill at Marmora. Portion of the open pit is seen at the left.

the sump level back to the control point and thereby balancing the input and output.

This circuit has worked well since its installation. A signal light, actuated by the back pressure on the probe, was added to the circuit to indicate high and low sump levels, and the original diaphragm pump handling thickener underflow was replaced by a centrifugal pump. Otherwise the circuit remains as it was originally installed.

Basically, the automatic controls in this circuit allow the filter operator to change at will his filter feed rate without having to make manually a corresponding change in the feed to the pump sump, which is located several floors below his filter station. The thickener feed and the underflow-filter circuits could be operated without automatic controls, but this would necessitate an extra man on each shift. In addition, manual operation would not be as reliable or as accurate as that achieved by instrument control.

AUTOMATIC ADDITIVE SYSTEM

The control system is now in the process of being expanded to regulate the addition of coal. Although the average filtering rate is known, the variation above or below average can only be estimated and the coal addition can be no more accurate than the operator's estimate. In order to meter the correct ratio of coal into the slurry automatically at all filter rates, the automation shown in Fig. 3 is being installed.

The material flow and the sump level controls will be the same as those shown in Fig. 2. However, the present splitter will be replaced by a splitter box and splitter assembly equipped with an overflow which will ensure a constant tonnage out of the bottom of the splitter box. This arrangement will allow the splitter to make an accurate and reproducible split even though the output of the centrifugal pump varies.

The control instrument in Fig. 2 (and shown in Fig. 3 as control *instrument No. 1*), which registers the variable back pressure according to the sump level as previously described, will now serve two purposes: it will adjust the tonnage of concentrate going to the sump by positioning the splitter, and it will adjust the rate of coal feed by regulating the control point of the No. 2 instrument in Fig. 3 by means of an indexing mechanism. Each point on the No. 1 instrument in Fig. 3 will correspond to an exact position of the splitter, a particular tonnage of concentrate going to the sump pump, and a particular tonnage of coal being called for by the No. 2 control instrument.

The No. 2 instrument will be equipped with proportional band and automatic reset mechanisms. This control instrument will utilize a signal from a tachometer-generator to vary the speed of the conveyor belt which feeds the coal to the system. The tachometer-generator signal will position the indicating needle on this instrument according to the belt speed. Corrections in belt speed will continue until the predetermined control point and the needle are in coincidence, at which time the required amount of coal will be added to create the desired ratio of coal in the slurry.

The indexing mechanism will be equipped with a span adjustment. This will be used to change the concentrate-coal ratio when necessary due to variations in the sulfur content of the concentrate.

SUMMARY

The controls on the thickener feed and underflow have worked well. Their installation has been more than justified by savings in labor cost and by a trouble-free operation. The coal control will eliminate a manual operation, and it is expected that it will be justified by eliminating a variable in the pelletizing plant and indirectly contributing to the improved quality of the final product.

The author is indebted to Mr. P. L. Steffensen, Manager of the Raw Materials Research Division, Bethlehem Steel Company, for permission to publish this paper and the aid given in its preparation.

BUCKET WHEELS IN GERMANY

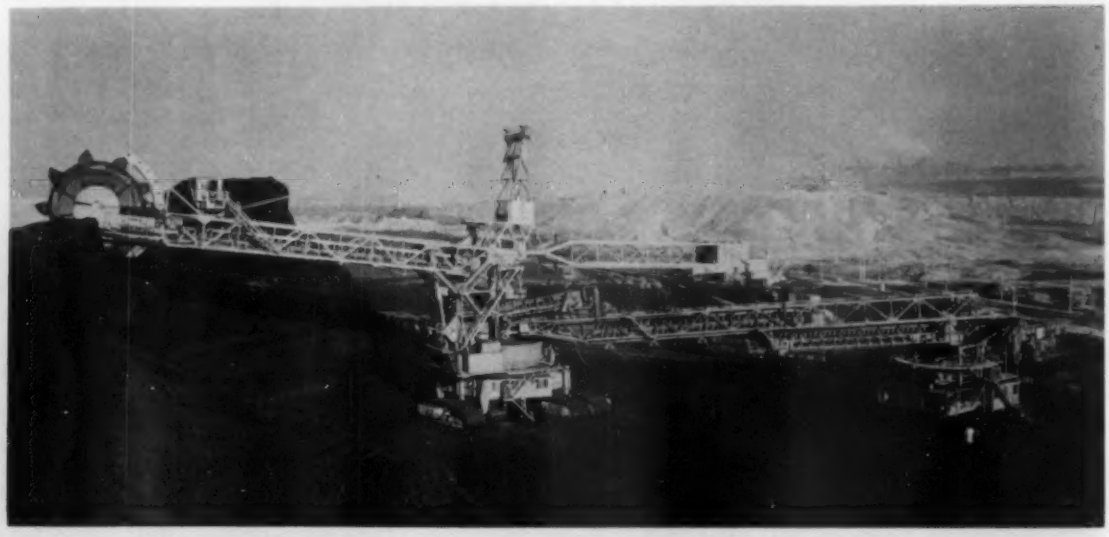
During the last 15 years, the bucket wheel has become increasingly popular as a mining tool. Being a large-capacity continuous mining excavator, the machine offers low actual operating costs and low unit costs. Of German origin, the bucket wheel has now appeared on the American mining scene as well as in such other places as Australia, Northern Rhodesia, South Africa, Congo, Indonesia, and India.

Patented in 1913, the first practical application waited until 1920 when a bucket wheel excavator was placed in operation at an open pit lignite mine in central Germany. This initial experiment met with little success due to difficulties in solving the technical problems of the machine's construction rather than to the design of the wheel itself.

It was not until 1936 that bucket wheel excavators came into their own. In that year, several machines were constructed which weighed 200 tons and were capable of handling 650 cu yd of material per hour. Today, giant bucket wheels are in existence weighing in excess of 6000 tons and with hourly excavating capacities of 11,000 to 13,000 cu yd of material.

The following photographs, provided through the courtesy of Fried. Krupp corporation in Western Germany, show some of the equipment employed in that country today for stripping overburden from coal deposits and removal of such material to designated dump sites, often situated many miles away from the actual mining operation.

EQUIPMENT FOR LARGE-SCALE

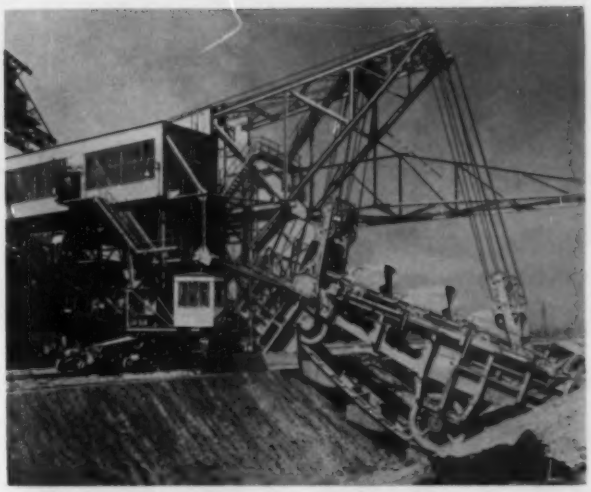


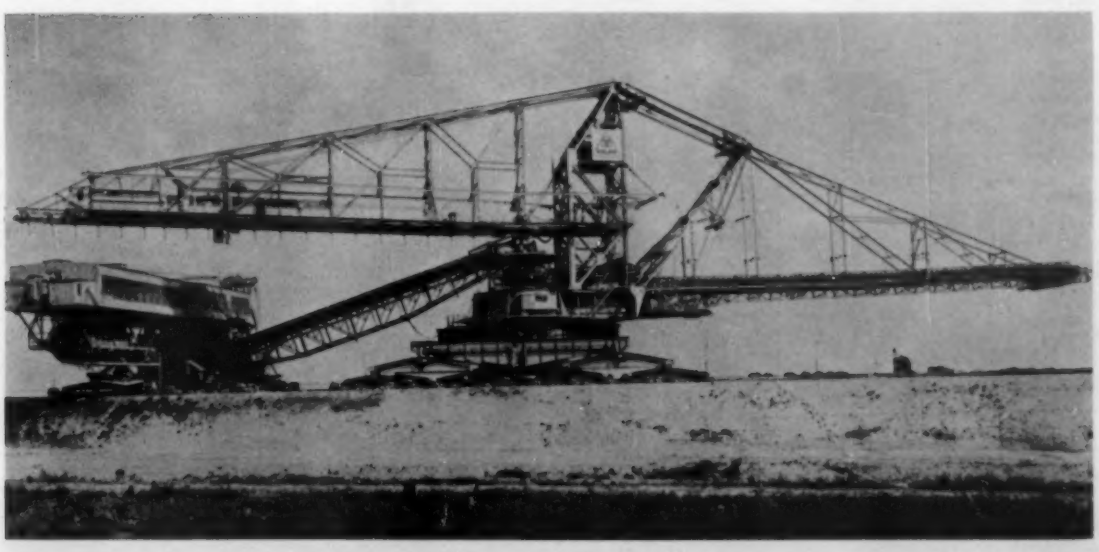
View of Krupp's largest bucket wheel excavator stripping overburden from a coal open pit mine in Germany. Constructed in 1953-1954, the machine weighs 6000 tons, has a 38-ft diam wheel, and can excavate 11,000 cu yd of material per hour. The bucket wheel boom (left) and the conveyor boom (to right of crawler tractor unit) are rotated independently of each other. On large-capacity bucket wheel excavators, an independent mobile loading unit (far right) transfers material from discharge conveyor of excavator to waiting rail cars for removal from mine workings. The mobile loading unit is connected to the discharge conveyor boom of the excavator by a conveyor bridge, seen extending from loading unit to underneath part of discharge conveyor boom. The equipment pictured on this and the next page are employed by one German coal mining company to handle overburden from its mine near Cologne.

In this large-scale coal mining operation in Germany, the dumping area is approximately 15 miles from the open pit. Railroads serve to carry the removed overburden from the excavator to the dump site. At the proper unloading destination, the side-dump cars pictured here empty the excavated material into a ditch running parallel to the rail tracks. A so-called "ditch bunker loader" (machine on left) scoops up this material and, by means of a conveyor belt, feeds it onto "spreaders" for disposal.

STRIPPING AT A GERMAN MINE

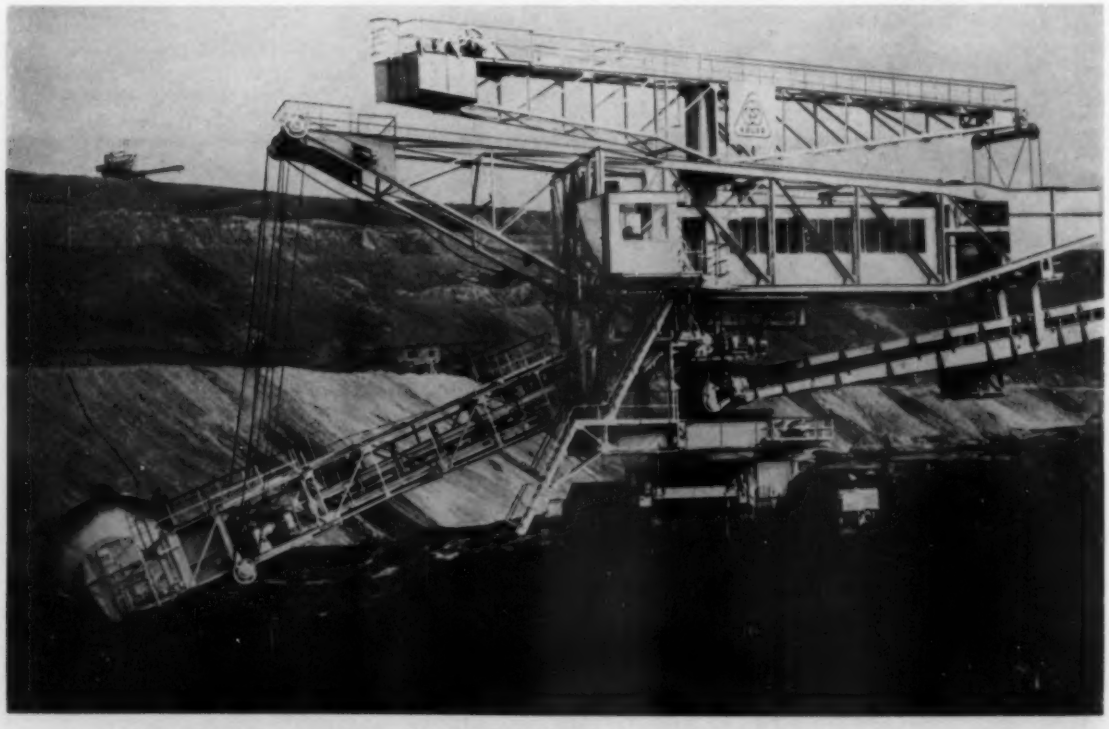
Detailed view of a ditch bunker loader. These loaders are usually employed only where a train serves to transport excavated overburden to the dump site. This particular unit is utilizing a bucket chain excavator which both digs the initial ditch and removes the overburden dumped into it from the rail cars. To an increasing extent in the last few years, the bucket wheel has been replacing the bucket chain in ditch loaders such as shown here.





This large spreader, built in 1955, acts as a mobile conveyor unit which receives excavated material from the ditch bunker loader (smaller machine at left) via a conveyor belt and discharges the material into a designated dumping area. The discharge boom (right) is 295 ft long, has a maximum dumping height of 112 ft, and can be pivoted in a 180° arc. The boom extending to the left of the spreader and over the ditch bunker loader acts as a counterweight.

Prototype of an underground bucket wheel excavator. To meet the narrow drifting widths in mines, two bucket wheels were placed as shown on the machine to obtain small free cutting angles in either horizontal direction. The basic design is similar to that of the larger excavators—wheel boom mounted on a pivotal superstructure, and a short independently operated discharge conveyor. The controls are located directly above the dumping point of the conveyor. This particular machine met with limited success in underground operations, but it was responsible for stimulating the development of other small-size bucket wheel excavators now in use at several open pit mines.



View of a bucket wheel excavator designed for both high and deep cutting. This machine is shown excavating overburden below the track level. Maximum cutting height of this particular excavator is 39 ft; cutting depth, 23 ft.

SME BULLETIN BOARD

Reports of Your Technical Society

October Events Across the Country

Alabama *September 30—October 1, Annual meeting of AIME Southeast Section in Birmingham, Ala. Members will not want to miss Section's biggest event. Two-day technical program leaves plenty of time for social events and Saturday football game. Registration starts September 29. More details on page 1024.*

Arizona *October 17-18, Symposium on Surface Mining Practices at University of Arizona's College of Mines. Wednesday morning field trip, October 19, to Asarco's new large-scale mine, the Mission Project, on outskirts of Tucson. Details on page 1021.*

Colorado

Denver, October 4-5, Board meetings, AIME and SME, coincide with SPE fall meeting, also in Denver. See SME Bulletin Board, July MINING ENGINEERING.

Golden, Colo., October 17-19, Drilling and Blasting Symposium, Colorado School of Mines. Full program, pages 1021-1022.

Indiana *October 5-8, Ninth Annual Clay Conference, Purdue University, Lafayette, Ind. Field trip and laboratory visits, October 5. Technical sessions, October 6-8. For further information, write Professor J. L. White, Local Chairman, Ninth Annual Clay Conference, Purdue University.*

Minnesota

October 7-8, Third Quinquennial Alumni Reunion, Minnesota School of Mines and Technology, Institute of Technology. Technical sessions, followed by banquet and dance. Saturday, October 8, Northwestern vs Minnesota football game. See page 1024.

Utah *October 5-7, Rocky Mountain Minerals Conference, Salt Lake City. See page 933, August* MINING ENGINEERING.

West Virginia *October 24-25, Joint Solid Fuels Conference, AIME-ASME, Charleston, W. Va. News of this meeting on page 1020.*

The last beam is lowered into place during topping out ceremony for the new center.

Workman lifting steel window grids for the glass-walled east base into position.

A dramatic scene from top of new center, flag flying, UN building in background.

American Flag Flies Over United Engineering Center During Topping Out Ceremony Held July 26, 1960

As the last steel beam for the United Engineering Center was lowered into place on July 26th, the American flag atop it rippled in the breeze, marking the traditional topping out ceremony. This ceremony is a repetition of prehistoric tradition to appease the wrath of the gods and bring good luck to the structure. Officials of the societies that will occupy the building watched the unfurling of the flag.

The 20-story, all-welded building, at United Nations Plaza and 47th Street, New York City, was fabricated and erected by Dreier Structural Steel Co. Inc., Long Island City. One of the innovations introduced into the steel frame by Seelye, Stevenson, Value & Knecht, consulting engineers, is that mechanical and electric conduits pass through the steel beams and girders, thus reducing story height.

During the week following the topping out ceremony the first stainless steel window grids were mounted. In the next few months some 170,000 lb of stainless steel will be placed on the building's exterior, including curtain wall mullions and column covers. The first stainless steel grids were fixed on the special two-story east base of the building where a glass wall 25 ft high will enclose an exhibit area.

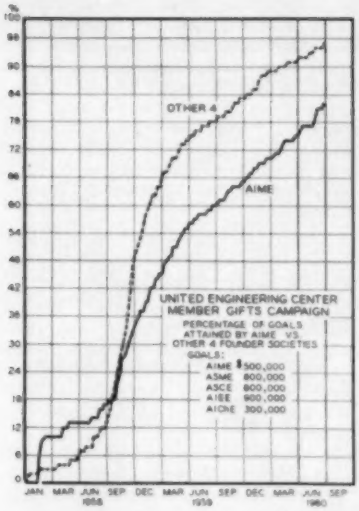
The basic curtain wall panel for the Center measures 12½ ft high and 5 ft wide. Inside a rectangular framing of stainless steel is a sheet of window glass and a sheet of colored spandrel glass. The two glass sections are divided by a stainless steel bar. Vertical and horizontal mullions were designed and fabricated into the curtain wall frame units. Adjacent frames will be center-joined as the panels are installed, resulting in a finished appearance of one-piece 4-in. wide mullions rising the full height of the building and spanning its breadth. This ingeniously simple mullion design will speed erection, give closer control over sealants, and lower construction costs.

The gleaming gridwork of mullions on the building will be further accented by five columns on the south and four on the north, rising from ground level to the top of the 283-ft structure. At the south base of the building where the columns are free-standing, four sections will surround them with stainless steel.

Taking advantage of design variations made possible by developments in color-coated stainless steel, the architects specified a band of black stainless steel fascia panels between the second and third floor, dividing the tower from the two-story lobby.

Officials of the sponsoring societies of the United Engineering Center watch topping out ceremony. From left to right: O. B. Schier, II, Secretary, The American Society of Mechanical Engineers; E. L. Chandler, Treasurer, American Society of Mechanical Engineers; Beatrice Hicks, Society of Women Engineers; Alta Samuels, Society of Women Engineers; Andrew T. Boggs, Technical Secretary, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.; C. E. Davies, Executive Director, United Engineering Center; Andrew Fletcher, President, United Engineering Center; Ernest Kirkendall, Secretary, American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc.; H. C. Cross, Executive Secretary, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, and (watching the beam ascend) N. S. Hibshman, Secretary of the American Institute of Electrical Engineers.

AIME Lags Behind Other Four Founder Societies in Member Gifts Campaign for Engineering Center



AIME members have not yet supported the Member Gifts campaign for the new United Engineering Center to the same extent as members of the other four Founder Engineering Societies, as shown in the accompanying graph. Some $90,000, or 18 pct, remains to be raised from AIME members to meet our quota of $500,000. Special efforts will be made to reach every member and to complete the campaign before the end of the year. Those who have not yet been approached should so advise the Chairman of their respective Local Sections who will gladly provide them with pledge cards, or they may communicate directly with AIME headquarters. Any pledge made may be paid in installments over the next three years.

The Chemical Engineers have already exceeded their quota by 6 pct, or by some $18,000; the Civils in August (at 99 pct) had but $9000 to go; the Electricals (at 94 pct) lacked $56,000; and the Mechanicals (at 88 pct) were $99,000 behind.

To date, 23 pct of AIME members all over the world have made pledges. A comparatively small percentage has refused to do so, for a variety of reasons. Perhaps half of the membership has not been specifically asked, but such members should not hold back any longer for this reason. Checks should be made payable to "United Engineering Trustees" and contributions are tax deductible.

FOR SALE

VENTILATION EQUIPMENT

Located New York City

Mechanical and electrical equipment for large ventilation system consisting of:

20—American Blower Corp. Centrifugal Fans

20—G. E. Induction Motors

Type K, 208V, 3ph, 60 cycle. Ratings as follows:

8—50/16/2.5 H.P.—900/600/300 RPM

2—32/4.1 H.P.—900/450 RPM

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Solid Fuels Conference Meets Oct. 24 and 25

The 23rd Annual AIME-ASME Joint Solid Fuels Conference meets October 24 and 25 at the Daniel Boone Hotel in Charleston, W. Va. In addition to the technical sessions a number of special events have been planned. A choice of four field trips arranged for Tuesday afternoon, October 25, caters to a variety of interests. Included are tours of a remote-controlled continuous miner operation at Union Carbide Chemicals Co.; coal preparation plant and bore-mining operations at the Carbon Fuel Co.; the Kanawha River plant of the Appalachian Power Co.; and the technical center for research, engineering, and development of Union Carbide Chemicals Co.

Monday's luncheon speaker will be Stephen F. Dunn, National Coal Assn., whose subject is *The Future of Coal is Not Black*. At Tuesday's luncheon Ivor F. Boiarsky will entertain guests with a tour of the Holy Land. Highlight of Monday night's banquet will be the presentation of the Percy Nicholls Award. The recipient will be announced at that time. The Honorable Cecil H. Underwood, Governor of the State of West Virginia, will be guest speaker. His subject: *West Virginia Coal Resources*. Entertainment will be provided by the Guildaires of the Charleston Light Opera Guild. The banquet will be preceded by a social hour sponsored by the Chesapeake and Ohio Railway.

The ladies will be kept busy with a program of their own, beginning with a coffee hour at the hotel on Monday morning. A tour of Blenko glass plant and a luncheon at Wren's Nest follow. They are of course welcome to attend the social hour and banquet that evening. Tuesday morning a tour of the State Capitol has been arranged, followed by a luncheon at the Edgewood Country Club.

There have been several additions to the technical program since it appeared in the August issue of MINING ENGINEERING. The complete program follows:

Session I, October 24, 9:30 a.m.

D. Davis, *Chairman*
A. Spotte, *Co-Chairman*

Mechanical Mining in Low-Seam (28 to 36-In.) Mines: *Clyde Storey*, Princess Elkhorn Coal Div., Princess Coals Inc.

What Industrial Consumers Look for in Purchasing Coal: *Donald M. Given*, Union Carbide Corp.

The Supplier's Viewpoint in Selling Coal: *C. R. Mobley, Jr.*, Island Creek Coal Sales Co.

Session II, October 24, 2:00 p.m.

M. L. Jones, *Chairman*
R. W. Precious, *Co-Chairman*

A Decade of Electric Utility Fuel Experience: *Myles E. Robinson* and *W. L. Kurtz*, National Coal Assn.

New Concepts—Coal from Mine to Industrial Boilers: *C. E. Day*, E. I. du Pont de Nemours & Co. Inc.

A Concept of Combustion Control for Firing Two Solid Fuels: *C. E. Rodenburg*, Rust Engineering Co.

Session III, October 25, 9:00 a.m.

J. B. Walker, Jr., *Chairman*
H. C. Skaggs, Jr., *Co-Chairman*

Volatile Matter in Coal and Its Relation to Pulverized Coal-Fired Units: *Jospeh F. Mullen*, Pittston Clinchfield Coal Sales Co.

The Comparison of Sulfur Analyses by Combustion Tube and Eschka Methods Using Coals from Various Seams and of Varying Sulfur Content: *E. J. Sandy*, West Virginia University.

Present Status of Underground Gasification of Coal in USSR: *C. D. Pears*, Southern Research Institute.

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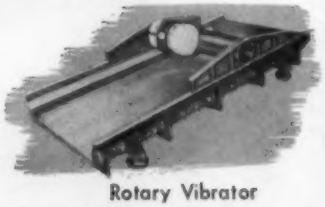

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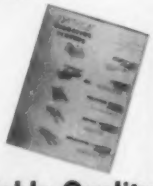

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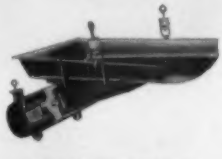

VIBRATORY FEEDERS

ROCK IN THE BOX

Mining & Exploration Division

1960 AMC Program

A wealth of material is packed into the four-day session of the 1960 American Mining Congress to be held October 10 to 13 in Las Vegas, Nevada. Broad topics to be considered include: national mineral policies; public lands; exploration and geology; general operating problems; a tax panel and forum; an industrial engineering symposium; open pit mining; labor relations, underground mining, milling, and metallurgy; state of the mining industries; uranium, gold, silver, and monetary policies; management tools and techniques; and an underground drilling symposium.

In addition, an extensive exposition of machinery, equipment, and related products will be featured. Special activities for the ladies have been planned and two field trips have been scheduled, one by plane to Kennecott's mining operations at Ruth and the other by bus to several southern Nevada plants. The ladies are welcome on the Kennecott trip but not the other. Because of the world-famous entertainment attractions of Las Vegas, no official AMC evening functions have been scheduled.

Plans for Underground Mining Session Set

Plans for the Mining and Exploration Division's participation in the technical sessions of the 1961 Annual Meeting in St. Louis continue apace. John J. Reed, program chairman for the underground mining session, recently disclosed the following tentative program. *Underground Use of AN-Fuel Oil Explosives* by John L. Ryon, Jr., International Salt Co.; *Boring Large-Hole Mine Openings* by E. A. Morlan, Hughes Tool Co., and Floyd Ray, Rayco Drilling Co.; and *Theory of Rock Bolting* by Thomas A. Lang, Bechtel Corp., are definite. Other possibilities include *Mining under Rock Burst Conditions*, speaker as yet unknown; *Experimental Model Studies of Failure of Underground Openings under Impulsive Loads* by John S. Rinehart, Colorado School of Mines; *Measurement of Rock Pressure with a Hydraulic Cell* by Louis A. Panek, USBM; and *Alimak Raise Climber* by B. R. Waples, Jr., Shattuck Denn Mining Corp.

To insure on-the-spot follow-up of program arrangements Reed, who has left St. Joseph Lead Co. to accept an appointment on the faculty of the Colorado School of Mines, named C. David Mann of Bonne Terre, Mo., as his co-chairman.

Geophysics

Don A. Hansen, program chairman, reports progress in planning the geophysics session, which now is called GEOPHYSICS FOR THE GEOLOGIST AND ENGINEER. Definitely scheduled is *Geologic Mapping with the Aid of Magnetics* by Malcolm Heyburn, Titanium Div., National Lead Co. A paper by George V. Keller, USGS, entitled *Geophysical Studies in Support of Geologic Mapping in the Twin Buttes Quadrangle, Arizona*, has been tentatively scheduled. Papers on air magnetic surveys and seismic method are still in the planning stage.

Surface Mine Practices Symposium Scheduled

The College of Mines of the University of Arizona, Tuscon, will hold a symposium on Surface Mining Practices October 17 and 18. The morning of October 19 a trip to the Mission Project of American Smelting & Refining Co. on the outskirts of Tuscon has been arranged for those who are interested.

Monday's luncheon speaker will be Reuben G. Gustavson of the University. A film provided by Marion Power Shovel Co. will be shown at Tuesday's luncheon. Highlight of the conference will be the banquet speech by The Honorable Barry Goldwater, U.S. Senator from Arizona.

The program for the technical sessions follows: Monday, October 17, 9:30 a.m., *Current Practices of Strip-Mining Coal* by Edwin R. Phelps, Pittsburg & Midway Coal Co.; *Limestone Quarrying, Production of Cement, and Related Problems at Oro Grande Plant, Riverside Cement Co., Div. of American Cement Corp.* by Gordon E. Pflug, Riverside Cement Co.; *Open Pit Mining of Phosphate Rock in the U.S.* by G. Donald Emigh, Monsanto Chemical Co.; and *Open Pit Operation of Three-Vein Gypsum Deposit by Back-Cast Stripping Method* by F. C. Appleyard, U.S. Gypsum Co.

Monday afternoon, 1:30 p.m., *Eagle Mountain Mine, Drilling and Blasting of Extremely Hard Rock; Use of 65-Ton Semi-Trailer Type Trucks* by Martin J. Hughs, Kaiser Steel Corp.; *Truck-Mounted Rotary Blasthole Drilling at Inspiration* by Thomas M. Anderson, Inspiration Copper Co.; *General Blasthole Drilling at Silver Bell* by Harry M. Conger, American Smelting & Refining Co.; and *Maintenance of Main Line Haulage in Morenci Mine* by David H. Orr, Phelps Dodge Corp.

The Tuesday morning session will consist of: *Computers and Computer Applications* by A. Wayne Wymore, University of Arizona; *Use of Digital Computer in the Calculations of the Economic Limits of an Open Pit Mine Expansion* by James F. Olk, Pima Mining Co.; *Comparison of Various Methods of Calculating Ore Reserves Using a Digital Computer* by Richard F. Hewlett, University of Arizona; and *Estimation of Shovel and Dragline Output for Systems Analysis* by Elmer R. Drevdahl, University of Arizona. In the afternoon the following topics will be discussed: *Use of Aerial Survey Mapping at the Esperanza Pit of the Duval Sulphur and Potash Co.* by F. H. Buchella, Jr., and Thomas Jancic, Duval Sulphur & Potash Co.; *Materials Handling at Ray Mines Division's Expanded Concentrator* by F. G. Woodruff and E. C. Speers, Kennecott Copper Corp.; and *The Open Pit Copper Mine* by William R. Hardwick, U.S. Bureau of Mines.

A coffee hour and tours of local points of interest have been planned for the ladies.

Symposium Scheduled on Campus at Golden

The Biannual Symposium on Drilling and Blasting, sponsored by the mining departments of the University of Minnesota, Pennsylvania State University, and Colorado School of Mines, will be held at Golden, Colo., October 17 through 19. The drilling symposiums originated with the University of Minnesota in 1950. This is the third to be devoted specifically to Production Drilling and Blasting. The

(Continued on page 1022)

Rock in the Box

(Continued from page 1021)

agenda was worked out by a committee of representatives from the sponsoring universities and industry with a view to meeting the needs of both the practical man in the field and the academician.

Registration begins October 16 in the Arthur Lake Library, where the technical sessions will also be held. During the morning session, Monday, October 17, the following papers will be presented: *Drag Bits and Machines* by R. H. Goodrich, *Lab and Field Testing of Rotary Rock Bits* by J. D. Medlock, and *Efforts to Develop Improved Oil-Well Drilling Methods* by L. W. Ledgerwood. In the afternoon: *Rotary Percussion Air Hammer Drilling* by W. E. Liljestrand, *Higher Air Pressures for Bottom-Hole Percussion Drills*, by E. P. Pfleider and W. D. Lacabanne, *The Galis Rotary Percussion Drill* by H. G. Pyles, *Drilling and Drill Steel Progress at the Idarado Mining Co.* by J. C. Keenan, and *Recent Developments and Trends in Production Blasthole Drilling on the Mesabi Iron Range* by D. K. Nelson.

On Tuesday morning, October 18, the following papers will be presented: *The Effect of Coupling on Explosive Performance* by T. C. Atcheson, *Application of the Livingston Theory* by Alan Bauer, *Some Effects of Particle Characteristics of Ammonium Nitrate on Blasting Agent Performance* by George B. Clark, and *Ammonium Nitrate Slurry Blasting Agents* by M. A. Cook. Tuesday afternoon's program includes: *Fracture Patterns in Salt* by Nicholas Short, *New Drilling and Blasting Techniques for Longer Rounds* by K. F. Lautmann, *Theory and Practice of Inclined Drilling for Surface Mining* by B. J. Kochanowsky, and *Drill Pattern and Initiation—Timing Relationships for Multiple-Hole Blasting* by R. L. Ash.

Wednesday morning a session for small discussion groups and a Symposium summary are scheduled. In the afternoon a visit to the laboratories of the U.S. Bureau of Reclamation at the Denver Federal Center has been arranged.

EDITOR

John W. Chandler

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Management Engineers to Meet in Chicago during Mid-September

The Eighth Annual Engineering Management Conference opens September 14 with an Early Bird Social at the Morrison Hotel, Chicago, from 4 to 6 p.m. The first session begins the next morning at 9:30 a.m.

Clarence H. Linder, General Electric Co., and Gerry E. Morse, Minneapolis-Honeywell Regulator Co., are luncheon speakers on September 15 and 16 respectively. Peter F. Drucker, New York University, will be guest speaker at the banquet on Thursday night, September 15.

A special program for the ladies has been arranged, including brunch at Top of the Rock, a bus tour of Chicago's South Side, a visit to Don McNeill's Breakfast Club (coffee and rolls will be served at the hotel for those not attending the Breakfast Club), and a luncheon and style show at Kungsholm Restaurant.

The tentative technical program for the conference follows.

IMPINGING FORCES is the theme of Session I, to be held Thursday morning, September 15. Papers to be given are: *The Economic Forces Shaping Business Policy* by Ralph Burgess, American Cyanamid Co.; *Impact of Technological Progress on Tomorrow's Management* by Estill I. Green, Bell Telephone Laboratories Inc.; and *Social and Political Forces Impinging on Engineering Management, or, Who Really Makes the Decisions and Why* by Clifford C. Furnas, University of Buffalo.

The subject of Clarence H. Linder's luncheon address is *Making the Commitment to Change. Managing Tomorrow* is the title of Peter F. Drucker's banquet speech.

Session II, to be held the afternoon of the 15th, has as its theme NEW REQUIREMENTS AND NEW AIDS FOR MANAGERS. Titles and speakers for this session are: *Mobilization of Data and Information for Technical and Management Decisions* by John S. Sayer, Documentation Inc.; *Engineers and Computists* by William A. Smith, Jr., Computing Laboratory, Lehigh University; and *Statistics as an Aid to Engineering* by Howard L. Jones, University of Chicago.

The Engineer's Participation in the Company and in the Community by Harold F. Smiddy, General Electric Co., and *Social Change in Science and Engineering* by Herbert A. Shepard make up Session III, IMPACT ON PROFESSIONAL PEOPLE, to be given Friday morning, September 16. The topic of the luncheon address is *Engineering Management in the Years Ahead* by Gerry E. Morse.

The theme of Session IV, to be held Friday afternoon, is IMPACT ON EDUCATION. Papers include: *Education and Development of Engineers as Managers at Inland Steel Co.—A Company Experience* by H. W. Johnson, Inland Steel Co.; *More Management or Less?* by Karl B. McEachron, Jr.; and *An Industrial Problem-Centered Student Development Program* by Charles L. Tutt, Jr., General Motors Institute.

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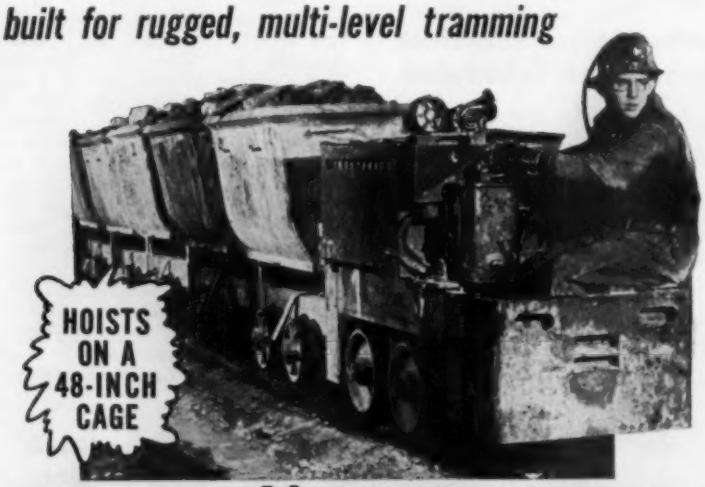

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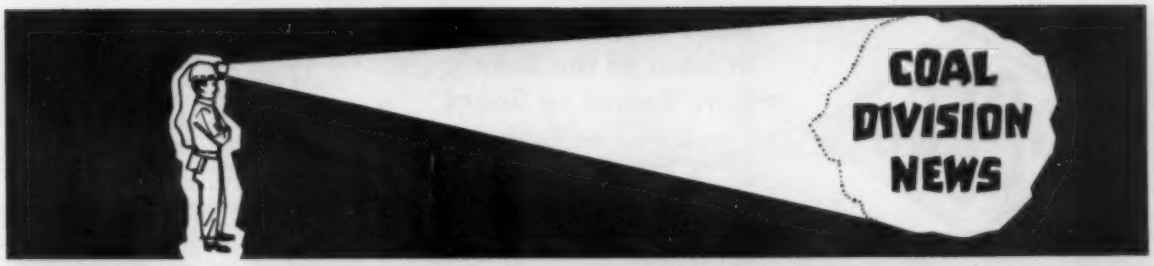


An excerpt from this letter about Wilbur A. Weimer appeared in the July issue of MINING ENGINEERING *as one of the biographies included on the nominations page. The editors found the full account so interesting that they want to share a substantial part of it with you in the belief that you too will enjoy it.*

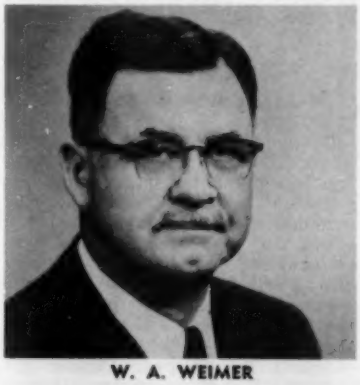
Wilbur A. Weimer, fifth son of a family of five boys and one girl, was born April 6, 1905, in Viola, Ill., then a small coal mining town in northwestern Illinois. His father was a coal miner, as was his grandfather. His mother, wanting to get her brood away from what she considered the dangerous occupation of coal mining, persuaded the father to buy a farm near the town of Girard, Kan. The family moved from Illinois to Kansas when Wilbur was six years old and the father worked the farm during the summers and he and the older boys worked in the mines near Pittsburg, Kan., and Joplin, Mo., during the winters.

Three of the older brothers, having mining in their blood, did not graduate from high school but did struggle for a mining engineering education and graduated from the Missouri School of Mines at Rolla. Each of the three went on in the mining profession to become well-known mining engineers and coal company officials. Two of these brothers passed away several years ago, and the surviving older brother, Walter, is chief engineer for Midland Electric Coal Co. at Farmington, Ill.

Wilbur attended the Kansas State College at Manhattan, Kan., for three years, 1925 to 1928, taking a mechanical engineering course. He became ill and withdrew in his junior year.

Weimer worked at construction and engineering in the Midwest and Far West for several years before being employed by the Northern Illinois Coal Corp. in 1936. He became chief engineer in 1943 and continued with the company until it was merged with Peabody in 1949. He was one of the few to remain with Peabody and has been chief engineer in charge of mines in Indiana and Illinois since the merger.

He has laid out and supervised the construction of ten large mines, two spur line railroads, and several

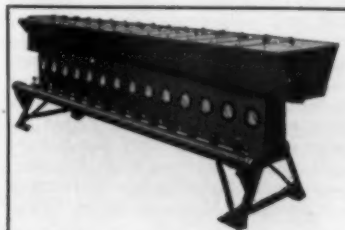


W. A. WEIMER

river loading docks. The achievement of which he is most proud is his part in inventing and developing the *Weimer Method of Stripping by Large Walking Draglines*, which his older brother patented.* It was largely through his persistence and development that coal was pumped in coal washers and that coal washery refuse was pumped away from the tipples. He has written and presented several papers on pumping coal washery refuse and has become an authority on these installations. The latest achievement has been the invention and development of the railroad-car haul system that has been used at some of the larger mines in the last five years. This system uses pairs of level loading tracks under a tipple where coal is loaded in trainload trips and moved without uncoupling the cars. They are moved by an endless wire-rope car haul attached to a larry car, which couples to and moves the train while it is being loaded. Weimer has also invented and developed the drive over truck-to-railroad-car loading stations. These stations consist of inclined earth ramps leading to the steel bridge-like structures that receive the coal from coal haulage trucks and chute it into the railroad cars. The chutes are actuated by hydraulic power. Trips of railroad cars are pulled under these structures by endless wire-rope car hauls, which really gave rise to the tipple car haul systems. One of Weimer's first mechanical improvements and inventions was the building of a bucket counterweight for a skimmer scoop coal loader which was instrumental in introducing the counterweights on large stripping shovels.

Weimer lives with his wife Nelle at their home in Belleville, Ill. He attends the local Methodist church and is active in the Illinois Mining Institute, AIME, and SME.

** In response to a query, Mr. Weimer writes: "The development of this method was responsible for the purchasing and manufacture of the first 30-cu yd draglines. This method is being widely used at the present time."*



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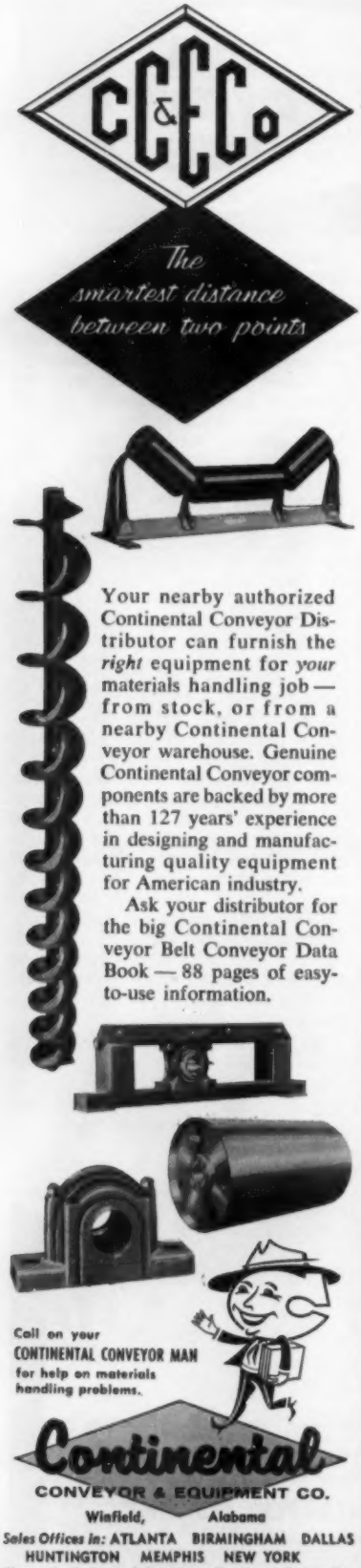
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Bechtel Named 1961 Winner of the John Fritz Award by Board

Stephen D. Bechtel was unanimously selected as recipient of the John Fritz Medal and Certificate for 1961 by the members of The Medal Board of Award. The award will be presented at the annual meeting of The American Society of Civil Engineers at the Hotel Statler in Boston on Wednesday, Oct. 12, 1960.

One of the highest honors bestowed by the engineering profession, the award was established in 1902 to perpetuate the memory of the late John Fritz's achievements in industrial progress. It is sponsored by the ASCE, AIME, AIEE, and AIChE.

The citation granting the award to Mr. Bechtel reads: "Engineer, builder, industrialist, and leader of broad vision in large construction undertakings, nationally and internationally—a pioneer in the creation and development of the modern construction industry, which is unequalled throughout the world and which has made possible the preeminence of our country in time of war and in time of peace."

Stephen D. Bechtel is president of the Bechtel Corp., San Francisco. He has been associated with the company for 42 years. Under his direction it has grown into one of the world's top-ranking engineering and construction organizations, involving activities around the globe.

Fall Reunion of Mines Alumni at Minnesota

The third Quinquennial Alumni Reunion of the Minnesota School of Mines and Metallurgy, Institute of Technology, will be held October 7 and 8, 1960. An open house and a technical session is scheduled for Friday afternoon, the 7th, at the new mines and metallurgy building. Outstanding achievement awards will be presented to several alumni at the banquet to be held that evening at the Nicollet Hotel. The banquet will be preceded by a cocktail hour and followed by a dance. On Saturday there will be an open house followed by the Northwestern vs Minnesota football game. Those planning to attend are urged to make reservations early for tickets and hotels by writing E. P. Pfleider, Mines and Metallurgy, University of Minnesota, Minneapolis 14, Minn.

Officers for 6th Annual Short Course Chosen

A new high in attendance was reached when 600 persons, including students from Canada, Cuba, and Mexico, registered at the fifth annual Appalachian Underground Corrosion Short Course held June 1, 2, and 3 at West Virginia University.

Plans are already under way for the sixth course to be held June 6, 7, and 8, 1961. Chairmen for the forthcoming year are: General Chairman, D. A. Tefankjian, Texas Eastern Transmission Corp.; Program Chairman, E. K. Bensen, N. Y. Telephone Co.; Exhibits Chairman, G. G. Campbell, West Virginia University; Publicity Chairman, John H. Alm, Dearborn Chemical Co.; and Registration Chairman and Secretary, R. E. Hanna, Jr., West Virginia University.

SME Member Sees USSR With EJC Delegation

An Engineers Joint Council delegation left June 22 for a month's visit to the USSR, where they will study the utilization and allocation of Soviet engineers and technicians. The trip, under the auspices of the National Science Foundation and the U.S. Department of State, is part of the Soviet-American program of scientific, technical, and cultural exchange.

Among the six delegates chosen by EJC was Robert M. Mahoney, a member of SME and manager, industrial relations development, Union Carbide Corp. The other members of the delegation are: Walter E. Lobo, delegation chairman, H. Russell Beatty, Carlton S. Dargusch, Oleg Hoeffding, and Sydney B. Ingram. They were chosen on the basis of professional training and experience and their knowledge of engineering manpower. A report of the trip appears on page 1008.

Southeast Section Two-Day Annual Meeting

The AIME Southeast Section will hold its annual meeting September 30 and October 1 at the Dinkler-Tutwiler Hotel in Birmingham, Ala. Registration begins Thursday night September 29 from 7 to 9 o'clock and will continue Friday morning from 8 to 10.

In addition to a full technical program, a number of social events, a field trip, and a special luncheon for the ladies have been arranged. David C. Sayles, chief of the Research Plans Branch, Redstone Arsenal, will be guest speaker at the welcoming lunch and Frank A. Rose, president of the University of Alabama, will be banquet speaker. A field trip to L. M. Smith Dam is planned for Saturday morning. Beginning at 5:00 p.m. that afternoon, there will be refreshments and a social hour, followed by a football buffet supper and, at 8:00 p.m., the football game between, Alabama and Vanderbilt universities.

Around the Sections

• The **Southeast Section** held its annual picnic at Lane Park on May 28. Attendance was short by just two of reaching 150. The affair was a huge success thanks to the efforts of John Cowin, Leland Johnson, George Bynon and their assistants and the cooperation of the weatherman, who provided clear weather throughout, after which it showered down.

• A dinner-dance honoring AIME President-Elect R. R. McNaughton was given by the **St. Louis Section** on May 13 at Le Chateau. Mr. McNaughton was dinner speaker, talking about Canada and Canadians.

• The **Tucson Subsection** (Arizona Section) met August 10 at the Holiday Inn, where members heard George Atwood, manager of Duval Potash & Sulphur Co., talk about the company's potash operation in New Mexico.

• Joseph L. Gillson, AIME President, was guest of honor and principal speaker at the **Pennsylvania-Anthracite Section's** annual summer meeting held June 23 at the Irem Temple Country Club, Dallas, Pa. Another distinguished visitor was AIME Secretary Ernest O. Kirkendall, who also addressed the gathering briefly. The meeting was open to AIME members, their wives, and adult members of their families. Emerson Todd and Tom Weichel, co-chairmen of the golf committee, arranged for interested members to play and awarded prizes. The outdoor swimming pool was also available to members who arrived early. Cocktails were served on the Club's veranda beginning at 5:30, followed by dinner in the Club's main dining room.

During the business session of the meeting the following officers were elected to take office immediately: Donald Markle, Jr., Jeddo Highland Coal Co., chairman; Paul Goddard, Carey, Baxter & Kennedy Inc., vice chairman; John T. Griffiths, Hudson Coal Co., secretary-treasurer. Members elected to serve on the executive committee for three years were: Roger J. Howell, Pennsylvania Dept. of Mines and Mineral Industries; John C. Earl, Ingersoll-Rand Co.; E. Harrison Edwards, consulting engineer; Francis E. Sterner, Lehigh Coal & Navigation Co.; and Michael S. Farrell, Susquehanna Collieries Div., The M. A. Hanna Co.

• The **Yavapai Subsection** (Arizona Section) met June 6 at the St. Michael Hotel in Prescott where the members heard an interesting talk by Gilbert Whitehead of Bethlehem Steel Co. He described the manganese operation the company is conducting at Amapa, Brazil.

• The **Wyoming Mining and Metals Section** held a dinner meeting on May 2 at the American Legion Club in Riverton at which SME President A. B. Cummins addressed the group of 75 on the activities of AIME and SME. Officers of the Section served as escorts to Mr. Cummins on a tour of the Gas Hills uranium district earlier in the day.

• The **Upper Peninsula Section** held its Spring Technical Session on Saturday, May 21, in the Civil-Geology building at the Michigan College of Mining and Technology in Houghton. Registration began at 9:00 a. m. and the program got under way at 9:30 with a welcoming address by John R. Van Pelt, Jr., president of the college. Papers presented included *Some Aspects of the Limestone Industry in Michigan* by Carl Hogberg, president, Michigan Limestone Div., U. S. Steel Corp.; a paper on cement operations in Michigan by Charles M. Adams, vice president of operations, Huron Portland Cement Co.; *Study of Potentials on Bubbles* by Myron G. Berry; and *Zeta Potentials on Goethite* by Ora Flaningam.

Social events included a coffee break from 11:00 to 11:30 a.m. sponsored by the Student Chapter and a social hour held at Douglas House at the end of the session followed by a steak dinner at 2:30 p.m. Opportunities to visit the Institute of Mineral Research and other college facilities were also available.

• A joint meeting of the **Montana Section** and the **Anderson-Carlisle Society** (the local student affiliate) was held May 25 on the Montana School of Mines campus in Butte. After a short business meeting the Anderson-Carlisle Society introduced five students who presented brief papers. George Grandy, a senior in mineral dressing, presented a paper entitled *Comminution Studies* dealing with efficiency in crushing and grinding circuits; Harold Coolidge, a graduate student in metallurgy, presented a paper called *Pyrometallurgy of Titaniferous Magnetite* dealing with the problems encountered trying to separate titanium from iron when they are bonded together in titaniferous magnetites. A third paper, *Salt-Dome Scale Models*, presented by Don Roberts, a senior in geological engineering, stressed the importance and usefulness of scale models in solving geological problems. *L.A.C.T. Units* by Robert Hoy, senior in petroleum engineering, dealt with the lease automatic custom transfer units now in use in transferring petroleum products from the producer to the pipeline company. The concluding speaker, Robert R. Utter, senior in mining engineering, presented a paper entitled *The Role of Ore Control*, which pointed out the economies to be gained by intelligent blending of different grades of ore. An informal refreshment period followed, presenting an opportunity for members to discuss the various papers with the authors.

• The **Adirondack Section** visited the recently completed Reynolds Aluminum plant northeast of Massena, N. Y., the afternoon of July 23. Many of the members met for lunch at the Highland Motel beforehand. The dinner meeting was held at the Elks Club in Massena at which Walter Hibbard, AIME Vice President, was guest speaker.

Panoramic view of Reynolds Metals' new aluminum reduction plant at Massena, N.Y.

Personals

A. E. REED

F. T. THOMPSON

W. C. MAHLIG

F. E. BARRON

The Iron Ore Co. of Canada, Montreal, recently announced the election of **W. J. Bennett** as vice president and director. Mr. Bennett was elected president and general manager of the Eldorado Mining & Refining Co. Ltd. in 1946 and later became president and general manager of Atomic Energy of Canada Ltd. Also during the years 1946 to 1958 he was president and general manager of the Northern Transportation Co. In 1958 he became executive vice president and general manager of the Canadian-British Aluminium Co. Ltd., and in June 1959 he was elected president and director of that company.

Fred C. Wrobbel, who had been working as power plant superintendent at Alcoa's Rosiclare works, has been transferred to the company's bauxite operations in the Dominican Republic as mine superintendent.

After three and half years with The Bunker Hill Co. as a geologist, **James A. Younger** has joined Union Carbide Nuclear Co. as a geologist.

American Metal Climax Inc. recently announced the appointment of **John W. Chandler** as manager of the mining department of its Mining & Exploration Div. He succeeds **C. A. R. Lambly,** who resigned to become president of The Trout Mining Co.

John C. Reed has become executive director of the Arctic Institute of North America, where he will be able to carry on his long-standing interest in polar research. He accepted this post upon retirement from the USGS after more than 30 years, the last 10 of which he served as staff coordinator in the office of the director.

Consolidation Coal Co. recently announced promotions of personnel within its organization. **D. H. Davis,** who for the past two years has been assistant to the vice president—operations, Consolidation Coal Co., has been named vice president—operations, Mountaineer Coal Co., with headquarters at Monongah, W. Va. **William O. Barnard,** formerly with Christopher Coal Co., where he was general superintendent, has been transferred to Mountaineer Coal as general superintendent of mine 32 at Owings and mine 63 at Monongah. **Charles R. Nailler** has been appointed vice president—operations, Consolidation Coal Co. For the past seven years he has been president of Christopher Coal Co., Morgantown, W. Va., and he will continue to make his headquarters there. **Harold Suter** will succeed Mr. Nailler as president of Christopher Coal. He has been vice president of the organization since 1956. **George L. Judy** becomes vice president—operations, Christopher Coal Co. He was formerly vice president of Mountaineer Coal Co.

W. S. Tyler Co. recently announced the creation of two separate divisions for marketing woven wire cloth and screening machinery. To direct the sales and pricing policies of the new divisions, **Albert E. Reed** was appointed vice president—marketing. He will also supervise the company's advertising, patent program, and license contracts. Mr. Reed has served as vice president of Tyler since 1942. Other appointments were: **F. Truman Thompson** as sales manager of the Woven Wire Cloth Div. and **Walter C. Mahlig** as assistant sales manager of the division.

Fernando A. Barrón, who has been general mine foreman for Northern Peru Mining Corp. for the past seven years, has been made assistant mine superintendent of the company's Quiruvilca mine.

Alvaro de Castro has become technical advisor to the Commission for Development of Guayana in Venezuela, after serving with the Ministry of Mines and Hydrocarbons in a similar capacity.

Gunter J. Bilstein, who had been an air tool specialist with Cook Bros. in Oakland, Calif., has moved to Lima, Peru, to take a position as mining engineer with Philipp Bros. Ore Corp.

Edward J. Hammer has been transferred to the Chicago office of U. S. Gypsum Co. from the New Brighton, N. Y. Plant, where he was working as project engineer.

John Polk Allen has been awarded the Mineral Engineering Fellowship for the first year of the two-year program leading to the Master's degree in business administration at Harvard Business School. The fellowship was established by leaders in the mining industry to encourage and help young men interested in working in mineral engineering to obtain broad training in administration. The fellowship is awarded annually to an outstanding graduate of the Colorado School of Mines. Since his graduation from the Colorado School of Mines in 1957, he has worked as mill metallurgist and senior metallurgist for Allegheny Ludlum and as a department head for Union Carbide.

P. C. Benedict, who is geologist for Newmont Mining Corp. and consulting geologist to Tsumeb Corp. and O'Okiep Copper Co., has moved his residence from Tsumeb, South West Africa, to O'Okiep, South Africa. Since February of this year business and vacation trips have taken Mr. Benedict to Australia, the U. S., Italy, and Southern Rhodesia.

J. M. W. Mackenzie, who had been a research student at the University of Otago Faculty of Technology, has joined Broken Hill Proprietary Co. Ltd., Newcastle, Australia, as a research officer.

Gregory E. Klosterman, formerly exploration geologist with St. Joseph Lead Co. in Desloge, Mo., has been transferred to the Viburnum district as resident geologist.

International Minerals & Chemical Corp. has announced as a major corporate objective the development and use of western phosphate. Heading this program will be **Carl A. Arend, Jr.,** who has been named project manager. He was manager for planning for potash operations. **Merton I. Signer,** formerly plant manager at Esterhazy, Canada, has been named field manager. It will be their responsibility to determine where the company will establish this major expansion, how the phosphate will be mined, and what type of refining facilities will be constructed.

W. E. Field, formerly a field engineer with Canol Metal Mines Ltd. in Edmonton, Canada, has moved to Vancouver, where he is working for Dolmage Mason & Stewart Ltd. as an engineer consulting on the Highbury tunnel.

Charles V. Harris, who for the past five years has been with the Defense Materials Service of General Services Administration at the U. S. Government-owned nickel plant in Nicaro, Cuba, has been transferred to Washington, D. C., where he has been assigned to the New Construction Branch of Public Buildings Service. Mr. Harris was honored by his alma mater, the University of Arizona, with a professional degree of metallurgical engineer at the commencement service June 1.

John W. Semmens has returned to his native England after two years in Mexico as assistant mine superintendent for San Francisco Mines of Mexico Ltd. He has accepted a position as general manager with British Industrial Sand Ltd.

Clayton E. Warren has left Canadian Dyno Mines, where he was assistant mine superintendent, to work at Asbestos Corp. Ltd.'s Normandie mine in Quebec.

J. P. A. Altorffer has returned to France to become assistant plant manager for Cie. du Cuivre et Durvumin after eight years with Société des Mines de Zellidja, in Morocco. He was general mills superintendent at the time he left.

Brown & Root Corp. Inc. of Houston, Texas, has established a new Canadian subsidiary, Brown & Root Ltd., naming **A. G. Kirkland** as president. Mr. Kirkland has been general manager of mines for Howe Sound Co., Salt Lake City, since 1957. Operations of the new firm will be based in Toronto.

Lee C. Armstrong, chief geologist for E. J. Longyear Co., has recently returned from a consulting trip to Aruba, one of the Netherlands West Indies group off the coast of Venezuela.

Ed S. Rugg recently became associated with the consulting firm of

Secretary of the Interior **Fred A. Seaton,** *left, awarded an honorary doctor of engineering degree, receives his sterling silver diploma from* **John W. Vanderwilt,** *president of the mineral engineering college of the Colorado School of Mines.*

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personals

continued

Shenon and Full, geologists of Salt Lake City. Before joining Shenon and Full, Mr. Rugg was chief geologist for American Chrome Co. and consultant to The Goldfield Consolidated Mines Co. of San Francisco.

The M. A. Hanna Co. recently announced the appointment of **Robert F. Anderson** as manager of domestic sales. He will be responsible for all iron ore and nickel sales activity in the U. S. and Canada. Mr. Anderson entered the mining industry in 1947 as an engineer with Butler Bros. Co., which was later acquired by Hanna. He has been assistant sales manager of the Ore Sales Dept. since 1958.

After five years as sales engineer with Eimco Corp. in Duluth, **W. R. Neil Currie** recently moved to Florissant, Mo., where he has taken a position as sales engineer with Nordberg Mfg. Co.

Paul Linz has been elected a director of Brandeis, Goldschmidt & Co. Inc. and will make his office with them as a consultant.

Dorr-Oliver Inc. has transferred **Robert E. Hochscheid** from Johannesburg, South Africa, to a newly established office in Santiago, Chile, as technical representative. In his new post he will serve Dorr-Oliver customers in Ecuador, Bolivia, Peru, and Chile, taking over and continuing the service formerly provided in this territory by **Herbert Hall,** who has been transferred to the head office in Stamford, Conn.

Addison H. King, formerly geologist with Stonefort Coal Mining Co., Indianapolis, has been made vice president and general manager of High Lime Rock Co. Inc., Miami, Fla., a subsidiary of Stonefort Coal Mining Co. and Sherwood-Templeton Coal Co.

George G. Witter, Jr., has opened his own office in Salt Lake City as a consulting geologist. He was formerly a geologist with General Petroleum Corp. in Salt Lake City.

Donald F. Wright, mining engineering senior from Bisbee, Ariz., and a member of the AIME student chapter of the University of Arizona, was one of two recipients of scholarships given by Kennecott Copper Corp. Selections were made by the College of Mines scholarship committee acting in conjunction with the Kennecott committee.

S. O. BRINGHURST

C. C. WHITTELSEY

Mine & Smelter Supply Co. recently announced the appointment of **S. O. Bringhurst** as manager of the Salt Lake City branch. He has been with the company for 30 years and until his recent appointment was assistant branch manager. He succeeds **William J. Berryman,** who has retired from active service after 43 years with the company.

Charles C. Whittelsey, president of the consulting engineering firm of Ford, Bacon & Davis Inc., was presented with an honorary degree of doctor of engineering by his alma mater, the School of Mines and Metallurgy of the University of Missouri, at its 87th annual commencement. Mr. Whittelsey gave the address to the graduating class. He has been with Ford, Bacon & Davis since 1925 and became president of the firm in 1957.

Consolidation Coal Co. recently announced the election of **G. Albert**

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G. A. SHOEMAKER

D. L. McELROY

Shoemaker as president of the company. Formerly executive vice president, Mr. Shoemaker fills the position left vacant by the recent death of A. R. Matthews. **Dennis L. McElroy** was elected to succeed Mr. Shoemaker as executive vice president. He has been a vice president of the company since 1947, first as vice president in charge of engineering, and in recent years as vice president in charge of operations.

Arthur L. Hall has been transferred from Cabot Carbon Co., Willsboro, N. Y., to the company's Pampa, Texas branch.

Glen A. Boyd, mining geologist for the Northern Pacific Ry., Seattle, has been appointed district mining geologist in charge of the railway's geology division activities in Washington, Oregon, and Idaho. He will continue to have his headquarters in Seattle.

Bernard C. Yearley was recently appointed vice president of the newly formed General Research, Development, and Engineering Div. of National Malleable & Steel Castings Co. of Cleveland. He was formerly assistant to the vice president, a post he has filled for the past five years. He has been with the firm since 1924.

Conrad W. Thomas, mineral industries consultant, has established an office in Rome, Italy, from which base he is available to conduct mineral investigations in Europe, the Middle East, and Africa. He is especially interested in assisting American companies that want to investigate opportunities in the European Common Market, and in consulting assignments on the rapidly developing African continent.

Mine Safety Appliances Co. recently announced two appointments to its manufacturing division. **K. L. Steele** was named director of manufacturing for all company operations. He was formerly manager of manufacturing for the Safety Products Div. **W. C. Hamilton** was appointed manager of branch plants, with supervision of all manufacturing activities outside the Pittsburgh area. He was formerly operations manager of the Mining Div.

Left to right: J. W. Vanderwilt, T. F. Adams, B. F. Zwick, V. L. Mattson, M. W. Bowen, and R. C. Earlougher.

Distinguished Achievement Medals were awarded to five Colorado School of Mines alumni during commencement exercises in May. Four of the five so honored are AIME members. Those who received the silver medal are: **Theodore F. Adams,** project manager of Blue River Construction Co.; **Max W. Bowen,** executive vice-president and general manager of Golden Cycle Corp.; **Robert C. Earlougher,** president and owner, Earlougher Engineering Inc.; **Vernon L. Mattson,** manager of mines and milling, Keer-McGee Oil Industries Inc.; and **Ben F. Zwick,** manager of oil and gas department, Chemical Bank-New York Trust Co.

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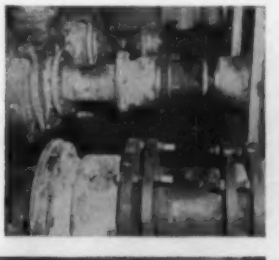

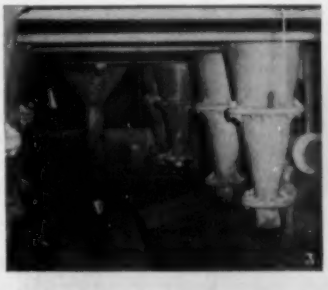

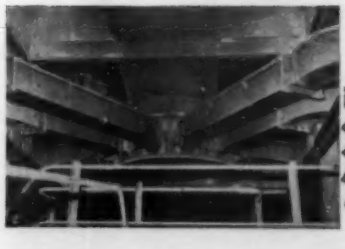

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1. View of Port pump well.
2. View of Linatex-lined distribution box and chutes.
3. View of cyclone underflow and discharge hopper.

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Obituaries

Earle C. Smith

An Appreciation by
Charles M. White

Smith is a common name. But when you add Earle C. in front of it, you have the name of an uncommon man.

Earle C. Smith (Member 1925) died May 20, 1960. Widely known and deeply respected chief metallurgist and director of research for Republic Steel Corp., he had an uncommonly close working and personal relationship with steelmen of all ranks from all over the world.

Further, he had the unusual ability to talk and to listen, to understand and be understood, by people in all walks of life.

He was patient, yet had a restless desire to get a job done. He was tolerant, but could not stand mediocrity. He could plan for tomorrow without losing sight of today.

He was born Jan. 20, 1891, in New Brighton, Pa., and was graduated from Ohio State University in 1913 as a mining engineer. He immediately went to work in the open hearths and rolling mills of Gary, Ind. He returned to Ohio State to teach metallography for several years. During World War I, he was affiliated with the U. S. Army Signal Corps in a civilian capacity to work with special steels for the aircraft industry.

Following the war he became chief inspector for Central Steel Co., a predecessor of Republic, in Massillon, Ohio. After a number of other assignments, he was appointed chief metallurgist for Republic in 1932 and in 1956 also was made director of research.

His many outstanding contributions to AIME included the Howe Memorial Lecture in 1935 and his chairmanship of the Iron and Steel Division in 1942 and the Fairless Award Committee in 1959.

Aside from the many tangible honors bestowed upon Mr. Smith, probably the greatest tributes to him are the many friendships he enjoyed throughout the world—friendships which represented a true cross section of mankind.

His education as a mining engineer and his thorough training in microscopic mineralogy gave him an insight into the problems of ore mining and ore beneficiation. While his forte was the production of iron and steel, his avocation was mineralogy. His broad background made him able to analyze and help solve ore problems no matter where they arose.

In 1942 he was a member of the American Steel Delegation to Great Britain. In 1958 he was selected to be a member of the mining delegation of the American Iron & Steel Industry Mission to the Soviet Union.

With his death, the mining fraternity has lost a stalwart supporter.

Yancey Lee James

An Appreciation by
Earl H. Beistline

Yancey Lee James (Member 1946) was born in Lancaster, Wis., Nov. 20, 1917. After graduating from high school in Chicago, he first came to Alaska in 1939. He entered the University of Alaska in January 1941 as a mining engineering student. His university career was interrupted by World War II in which he served with distinction. After the war, he returned to Alaska and graduated from the University of Alaska in 1950 with a B.S. in mining engineering. During his undergraduate years, Yancey spent his summers working in the mining field, and as a result, traveled widely throughout Alaska, becoming well known to many miners and residents of the state.

At the outbreak of the Korean War, he was again called into active service. Along with other overseas duties, he had direct responsibility for operating several mines in Korea.

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After completing his tour of duty, he returned to the U. S. and completed academic work for a LL.B. degree at the University of Utah in August of 1954. Returning to Alaska, the state he had grown to love and where many of his friends resided, he began work with the Federal Electric Co. as supervisor of depot level maintenance for the DEW Line, which necessitated many trips along the Arctic Coast.

Yancey James was licensed to practice law in Alaska and was a member of the Alaska Bar Assn. as well as being a member of the Utah State Bar Assn., American Bar Assn., and the Delta Theta Phi Law Fraternity. He was a registered professional mining engineer in Alaska, president of North American Mining Corp., a member of AIME, and a member of the Sons of the Revolution. At the time of his death, June 4, 1960, Yancey was chief of the Title Unit Right of Way Section, Division of Highways, Department of Public Works in Fairbanks, Alaska.

W. Lorrain Cook (Member 1917) died March 30, 1960, at the age of 81, following a long illness. Born in Burlington, Iowa, he moved to Chicago while still a boy and attended public school there. He received his professional training at Massachusetts Institute of Technology, where he graduated with a B.S. in mining engineering. In the early years of the century, from 1903 to 1917, much of his career was spent in Mexico and South America developing and operating a diversity of mines, including gold, copper, silver, lead, zinc, and iron. He also undertook examination of a large nitrate area in Chile. In 1922 he took a position as valuation engineer with the U. S. Treasury Department, the position he held at the time he became a member of AIME. He had been retired for many years.

Walter K. Farst (Member 1956) died recently at Zanesville, Ohio. He was born Nov. 24, 1904, in Barberton, Ohio. He graduated from Ohio State University in 1928 with a B.S. in civil engineering. Following graduation Mr. Farst went to work for Columbia Chemical Div. of Pittsburgh Plate Glass Co. as a field engineer. He was still with the company at the time of his death, holding the position of general manager of the Columbia Cement Div.

Fred K. Houston (Member 1950) died in Los Angeles, April 13, 1960, at the age of 77. A native of Pennsylvania, he attended Pennsylvania State College for three years, then transferred to Michigan College of Mines, from which he graduated in 1905. After leaving school he worked as assayer and engineer in the U.S., Canada, and South America. From 1911 to 1921 he was with the Department of Interior as a mineral examiner, except for a brief period from 1918-1919 when he was serving with the U. S. Army. He moved to California in 1937 and since 1944 had been vice president of The Ralph M. Parsons Co. in Los Angeles.

R. M. Macauley (Member 1911) suffered a fatal heart attack, April 7, 1960. Born Oct. 6, 1884, in Montreal, he graduated from McGill University with a degree in mining engineering in 1907. After several short-term jobs he joined Canadian Copper Co. in 1908 as assistant mine engineer. From 1918 to 1933 he was with Consolidated Mining & Smelting Co. of Canada. In November of 1933 he became vice president of Quebec Gold Mining Corp. Two years later he became affiliated with Pamour Porcupine Mines Ltd. During the last decade, Mr. Macauley had been living in retirement at his home in Montreal.

Burton M. Reynolds (Member 1944), 61, chief, Rolla office of mining research, the USBM, died Feb. 8, 1960, at Rolla, Mo., following a heart attack. He was born on Nov. 22, 1898, in Toledo, Ohio. In 1923 he graduated from the University of Washington with a B.S. in mining. His first job after finishing school was that of mining engineer with Calumet & Arizona Copper Co. in Arizona and the following year he went to Mexico, serving Cananea Consolidated Copper Co. in the same capacity. He first went with the USBM in 1943, staying until 1945, and returned in 1948.

Louis M. Wolford (Member 1959) succumbed to a heart attack Jan. 6, 1960. He was born July 24, 1898, in Freeport, Pa. He attended the School of Applied Industries, Carnegie Institute of Technology, and the University of Pittsburgh. From 1929 to 1936 he was assistant to the production manager of Mine Safety Appliances Co. and for the next five years was safety engineer, on all types of industrial operations, for the Fidelity Casualty Co. of New York. From 1941 to 1947 he was safety engineer on military and civil works construction for the Department of Defense. At the time of his death Mr. Wolford was chief of the Safety and Health Branch, U. S. Department of Labor.

Necrology

Date Elected	Name	Date of Death
1927	Glen L. Bateman	Jan. 24, 1960
1910	H. H. Crease	1959
1914	E. H. Dickenson	June 8, 1960
1910	Heitaro Fujita	Unknown
1917	George H. Gilman	June 28, 1960
1939	Franklin E. Johnson	March 15, 1960
1901	Horace Moses (Legion of Honor)	June 20, 1960
1914	Ira L. Wright	June 16, 1960
1940	Jose R. Yanez	1958

Membership

Proposed for Membership
Society of Mining Engineers of AIME

Total AIME membership on July 31, 1960, was 34,086; in addition 2,529 Student Members were enrolled.

ADMISSIONS COMMITTEE

S. S. Cole, Chairman; F. A. Ayer, Vice Chairman; F. Wm. Bloecher, Jr.; Jack B. Graham; C. H. Lambur; Pauline Moyd; R. H. Ramsey; A. D. Rood; W. J. Rude.

The Institute desires to extend its privileges to every person to whom it can be of service, but does not desire as members persons who are unqualified. Institute members are urged to review this list as soon as possible and immediately to inform the Secretary's office if names of people are found who are known to be unqualified for AIME membership.

Members

Floyd E. Bean, Baguio, P. I.
Russell A. Brant, Columbus, Ohio
Earl V. Chettle, Salt Lake City
Rene M. Chouteau, Abidjan, French West Africa
Robert T. Davis, Rabul, Afghanistan
Glen O. Ekstrom, Jr., Stamford, Conn.
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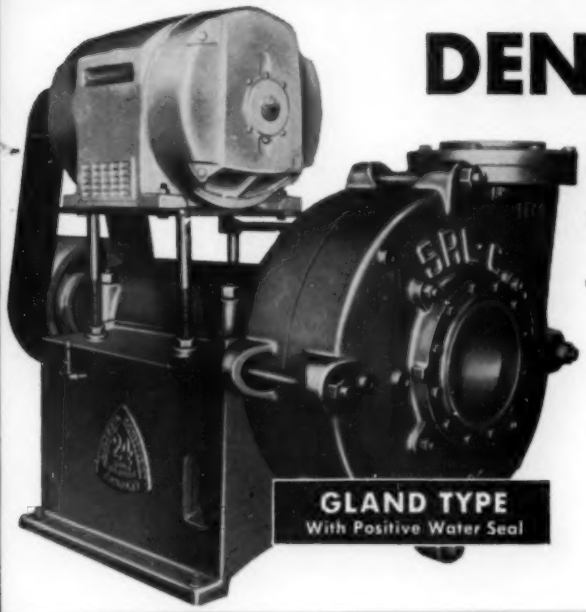

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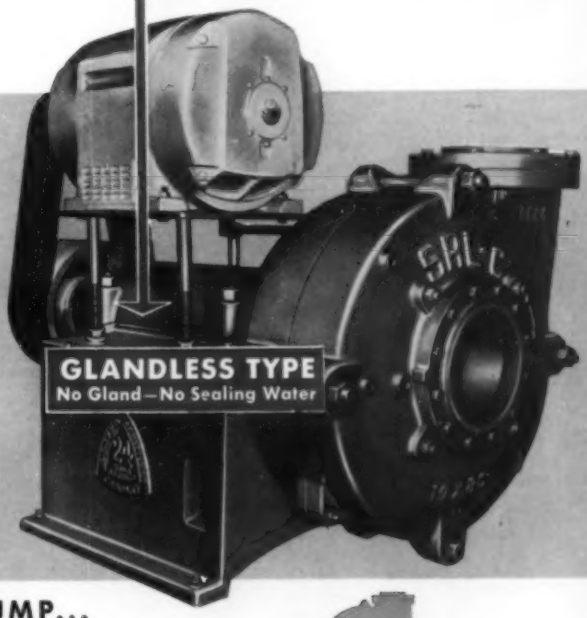

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Specifications and Dimensions

Pump Size and Type	Capacity 60' Head RPM	HP	*Water GPM	Dimensions (In.) L	W	H	Approx. Ship. Wt. Lbs.
GLAND TYPE							
1½"x1¼"	2190	1.9	40	25	17½	26	525
2½"x2"	1500	4.9	160	25½	17½	26⅜	575
3" x3"	1400	6.8	260	31¼	19¾	31½	850
5" x5"	1060	17.4	800	37¾	26¼	36½	1550
6" x6"	1170	36.3	1600	45¼	28½	46½	2300
3" x3"—C	1450	8.2	260	37½	21½	33¾	1240
5" x4"—C	1035	12.6	700	40¼	27	37⅝	1600
8" x6"—C	920	39.8	1600	63	36½	49¼	4375
10" x8"—C	820	74.0	3300	68¾	43	57	5100
12" x10"—C	615	115.0	5000	69⅝	46½	63	5900
GLANDLESS TYPE							
3" x3"—C	1450	10.0	180	37½	21½	33¾	1240
5" x4"—C	1035	15.0	500	40¼	27	37⅝	1600
8" x6"—C	920	47.0	1200	63	36½	49¼	4375
10" x8"—C	820	87.0	2700	68¾	43	57	5100

*Based on water. Multiply horsepower by specific gravity of pulp to obtain actual brake horsepower.

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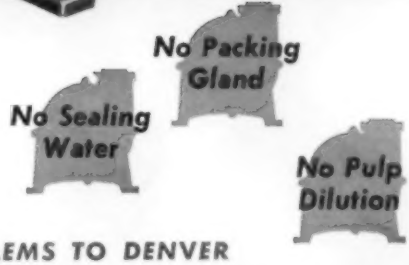
DENVER SRL Pumps with positive water seal already have a world-wide reputation for their high efficiency, low part cost, long life. If dilution of pulp or slurry is a problem, you now get the extra advantage of "TRU-GLANDLESS" construction. Requires no sealing water, no packing glands, eliminates pulp dilution.



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